AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

VOLUME 20. NEW YORK, THURSDAY, SEPTEMBER 16, 1897. NUMBER 37.

Staking Tools.

BY A. H. CLEAVES, CHICAGO.

Fig. 1 shows elevation, section and plan of a watchmaker's or jeweler's staking tool, such as is sold at the supply stores, accompanied by a set of tools like *a*, only made in a variety of forms to suit a legion of requirements.

The circle of holes *b* revolves around the central stud *c*, and being located as shown

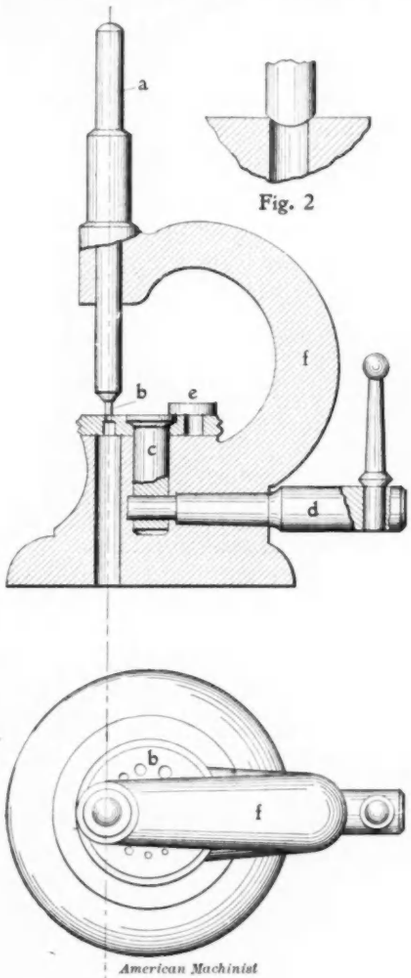

Fig. 2

Fig. 1

A STAKING TOOL.

at *b*, is tightened with the eccentric stud *d* drawing down *c*. The piece *e*, or similar pieces, can be used in the revolving block *b* for numerous purposes.

Thus in Fig. 2, a round-nosed tool is used for closing the entrance to a hole, making, in many instances where nothing better is required, a tight fit for a pin; or what is frequently of great service, a good hold on an arbor for turning off work. The arbor may fill the hole, but not be tight enough to prevent the work from slipping, and this will remedy the trouble without injuring the hole, generally, in any way. A reamer can be passed through the hole, if needed, to restore the original size. It is needless to say that this and similar tools can be used without the stand *f*, as the principal benefit derived from this is in getting the tools and work opposite and upright.

This tool can be used in ways too numerous to mention, and which may be suggested by any case in hand; such as using the spindle *a* for a tap or broach holder, center-punch, chasing tool, letter or figure stamp for marking work or taking impression from matrix; light punch and die work, with use of stripper—such as holes in flat springs, etc., etc.

In Fig. 3 a plan and side elevation of a more substantial staking stand for machine-shop use is shown. This is constructed in two parts, and held at the joint with two screws, as shown in the drawing.

The neck or yoke *a* in this stand should be made stocky, as in a punch-press to stand jar and strain; and a number of such tools can be made for small manufacturing purposes to good advantage—say, a dozen to be used as required. Special shapes of a stand like this can be designed to meet any requirement; but a few applications of this one may do now.

For example, in Figs. 5, 6, 7 some useful hints about staking work together may be found. Fig. 7 is a section and plan of the work to be done; a plate *a* being staked on to *b*—a stud or collar, as it may be. It will be seen in Fig. 7 that the work is held in position by four square lips in *b*, forced into four corresponding impressions in *a*. This method not only keeps the work from turning, while holding it together, but takes the place of dowel-pins in fastening parts in some positive position—as a cam or single-tooth wheel on to a multi-toothed wheel or another cam—and is very serviceable in adding or registering machines, cyclometer parts, and similar flat work that must be placed and held firmly in some definite relative position. The impressions are first made in *a;* then *b* is located as shown in Fig. 5, and the four lips on same made with the punch that impressed *a*.

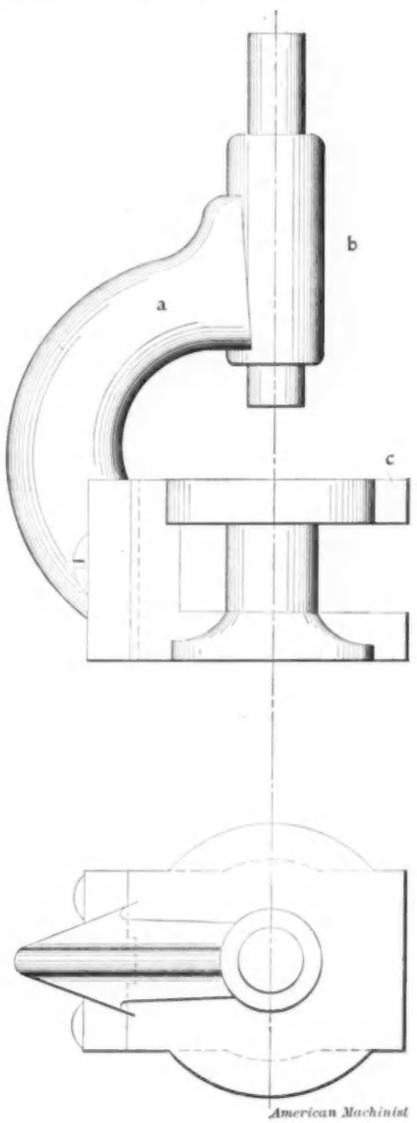

Fig. 3

A HEAVIER STAKING TOOL.

It is true that a great part of this line of work can, of course, be done in a regular punch press, and frequently to better advantage. But presses are expensive, and these tools are cheap, and easily located

near a window, in a small space. In many instances they are more convenient than a press, and do all that a die would do, while dispensing with a press and power. There are many small tools that can be used to advantage in small manufacturing, in place of expensive machinery, and the staking tool comes under this head.

Where the parts to be held are not expected to stand a heavy turning strain, staking like that shown in Fig. 8 is very effective; and such a punch as *a* can be made for the staking stand, or to be used without it like a prick-punch.

The grip obtained in this way by expanding *d* against the body of metal in *c*, is much stronger than when *c* is closed in upon *d*, as shown at *b*. Watch wheels and pinions are fastened very securely by the first method.

Still, dowel-pins can be tightened very effectively with a hollow stake like that shown in Fig. 9. Where this kind of staking is done, if a groove is turned in the pin or wire, as shown at *a*, Fig. 9, it will not fall out of bed in its sleep. Hand punches or stakes like this are a good thing to have, to use with some regular-size wire for dowel-pinning, one-eighth, three-sixteenths, etc.

Fig. 5 will show one of many methods of arranging staking tools. Enough of the stand is used in this cut only to show the action of the working parts. In Fig. 5, *b* corresponds to *b* in Fig. 3, and *c* to *c* in the same, or the guide-post and table of the stand. *a*, Fig. 5, is a cast-iron handle, with three or four headless screws *d d'* to run in the groove *e e'* in the stand *b*. This handle is threaded at *f* to carry the hollow plunger *f* up and down. This plunger or spindle carries *g*, with its accompanying parts for holding the plate *h* in position. This is the same as *a*, Fig. 7.

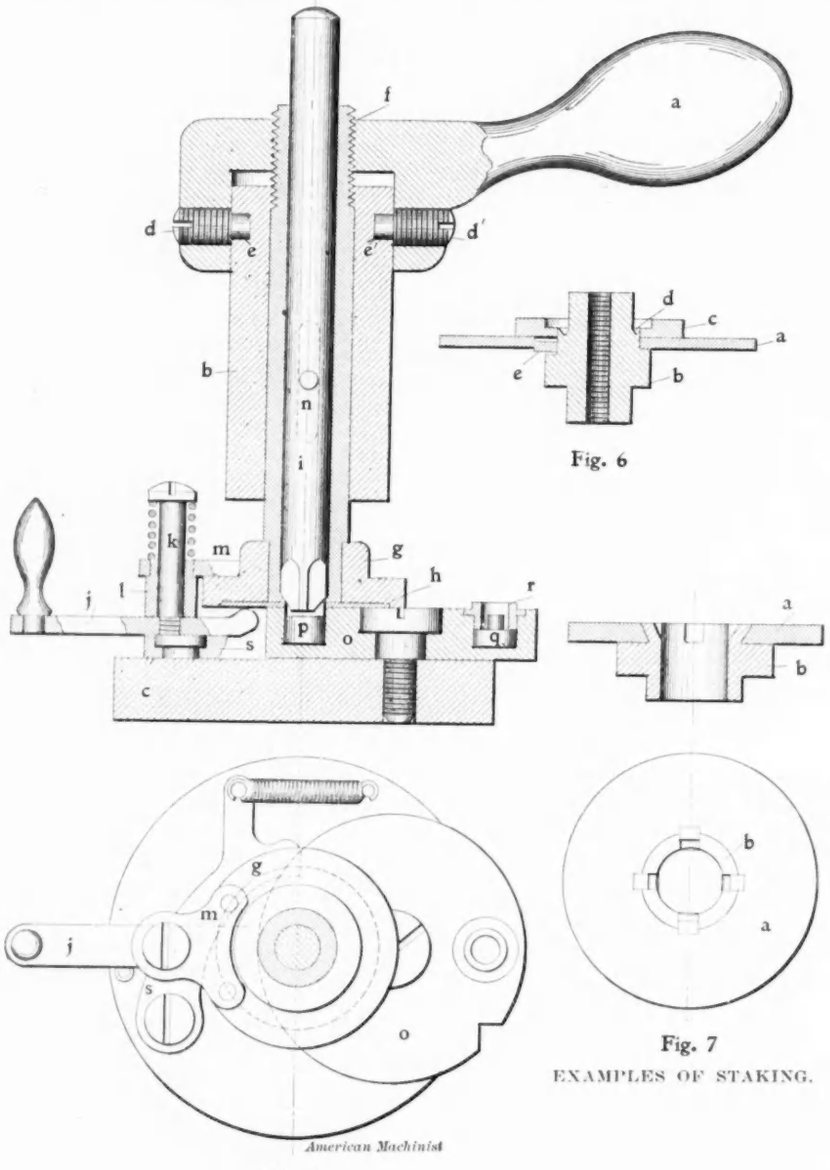

Fig. 5

SECTION AND PLAN OF STAKING TOOL.

Fig. 6

Fig. 7

EXAMPLES OF STAKING.

When the spindles *f* and *i* are up, the plate *h* is placed in *g*, and held in position by the swivel clamp *j*. The clamp swivels on the shoulder screw *k* with spring tightener; the bearing *l* stopping the clamp where it will slide onto *h* easily. This bearing is secured in *m*, which is fastened to *g*, as shown riveted in Fig. 5. A pin *n* aligns three slots in *b*, *f* and *i*, so that the spindles *f* and *i* are prevented from rotating. The circular block *o* revolves on a shouldered screw, and the two holes in this block, *p* and *q*, are in turn brought under the spindle *i* and held by the pawl *s*. The plate *h* is first held over the hole *p*, the center hole in *h* being the same size as *p*. The handle *a* being whirled down, fastens *h* firmly, while *i* is struck with a hammer to make the impressions; having four wings for the purpose. A hardened block in *p* acts as a stop for *i*, and gages impressions in *h*. The handle *a* is now whirled up, carrying *h* with it, which is held in place all the time by *j*. Then the stud or collar *r*, which has been placed in the hole *q*, is swung around to where *p* was, the pawl locating the same way. A hardened plug under *r* acts like the other, to stop *i* and gage the impression. The handle *a* brings the two pieces close together before staking.

Fig. 6 shows three pieces held by staking; but while *d* and *c* are fastened very tightly, *a* is not held well from turning.

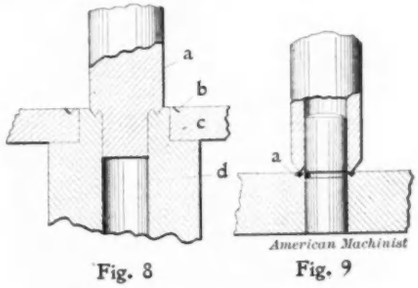

Fig. 8 Fig. 9

EXAMPLES OF STAKING.

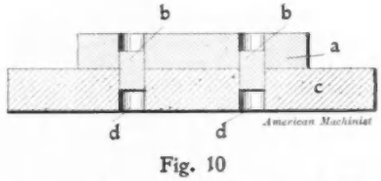

Fig. 10

DOWEL-PINS FORMED BY PUNCHING.

This is remedied by making three sinks on the shoulder of *b* at *e*, and three projections on *a* to correspond. The latter are made by punching the stock partially through, as shown at *e*. This prevents the piece *a* from turning.

Fig. 10 illustrates a similar method for making dowel-pins and putting them in, all at once. The pins *b b* are partially punched out of *a* to correspond with holes *d d* that have been, or are, separately punched in *c*. They work very nicely in watch plates.

The Locomotive Link Motion—IV.

BY F. A. HALSEY.

THE PROPORTIONS OF THE LINK MOTION.

Of design, in the sense in which that word is understood in connection with most other lines of machine work, there is very little connected with link motion. As the outgrowth of long experience, the leading dimensions of the gear are largely stereotyped in any given locomotive works, and between the work of different builders the differences are small. The following table of dimensions, taken from representative engines of various sizes as built by the Schenectady Locomotive Works, gives some of the leading dimensions. As contrasted with stationary practice the lap for any given travel of valve is much smaller, because the cut-off in the full gear is later than would be employed in any stationary engine having a fixed cut-off, and because an increase in the lap would reduce the port opening at short cut-off. The exhaust edge of the valve varies in design between about 1-32 inch lap and ⅛-inch clearance, the clearance being usually given to passenger engines.

PROPORTIONS OF REPRESENTATIVE LINK MOTIONS.

SIZE AND CLASS OF ENGINE.	Travel of Valve.	Throw of Eccentric.	Lap.	Length of Link between Pin Centers.	Dimensions of Steam Passage.	Passage Area as a Percentage of Piston Area.	Diameter of Drivers.	Speed M. P. H.	Piston Speed, feet per Minute.	Velocity of Exhaust Steam through Ports, feet per Second.	Passage Area as a Percentage of that required by Stationary Engine Rules.
	1	2	3	4	5	6	7	8	9	10	11
13x18 N. G. 8 Wheel Frt. & Pass.	5	4¾	¾	10½	12 x 1⅛	.099	49	30	620	105	.95
14x18 Forney Suburban	5	4¾	¾	10½	12 x 1⅛	.088	43	25	590	112	.89
15x22—8-Wheel Frt	5½	5¼	¾	12	14 x 1¼	.099	63	30	585	99	1.01
15x22—8-Wheel Pass	5½	5¼	⅞	12	14 x 1¼	.099	63	35	680	115	.87
16x24—8-Wheel Frt	5½	5¼	¾	12	14 x 1¼	.087	63	30	640	123	.81
16x24—8-Wheel Pass	5½	5¼	⅞	12	14 x 1¼	.087	68	35	690	132	.76
17x24—8-Wheel Frt	5½	5¼	¾	12	16 x 1¼	.088	63	30	640	121	.83
17x24—8-Wheel Pass	5½	5¼	⅞	12	16 x 1¼	.086	68	35	690	131	.76
18x24—8-Wheel Pass.	5½	5¼	⅞	12	16 x 1¼	.079	67	35	705	149	.67
19x24—10-Wheel Frt	5½	5¼	¾	12	18 x 1¼	.08	63	30	640	134	.75
19x24—10-Wheel Pass	5½	5¼	⅞	12	18 x 1¼	.08	68	40	790	165	.61
19x24—8-Wheel Pass	6	5¾	1⅛	13	20 x 1⅜	.097	75	45	805	138	.72
20x24—8-Wheel Pass	6	5¾	1⅛	13	20 x 1⅜	.088	73	45	830	157	.64
20x24—10-Wheel Frt	5½	5¼	¾	12	18 x 1¼	.072	63	30	640	148	.68
20x24—10-Wheel Pass	5½	5¼	⅞	12	18 x 1¼	.072	68	40	790	183	.55
20x26—10-Wheel Frt	6	6	1	13	18 x 1⅜	.079	57	25	635	134	.75
20x26—10-Wheel Pass	6	5¾	1⅛	13	18 x 1⅜	.079	68	40	855	180	.55
20x26—Consolidation slow Frt	5½	5¼	¾	12	18 x 1⅜	.079	50	20	585	123	.81
21x26—Consolidation slow Frt	5½	5¼	¾	12	18 x 1⅜	.072	50	20	585	135	.74

From the above table it will be seen that, with a valve travel of 5 or 5½ inches, the lap in freight locomotives is uniformly ¾ inch. In the case of the 20 x 26 ten-wheeled freight engine, in which the travel is 6 inches, the lap becomes 1 inch. In the case of passenger engines having a travel of 5 inches, the lap is ¾ inch, and in case of those having a travel of 5½ inches, ⅞ inch. When passenger engines having a travel of 6 inches, the lap becomes 1⅛ and 1¼ inches. The difference between the travel of the valve and the throw of the eccentric usually grows out of the location of the point at which it is convenient to locate the rock shaft; this point being ordinarily such as to make the lower end of the rocker arm somewhat shorter than the upper end. To provide for lost motion and wear due to the numerous joints, it is customary to give the eccentric such a throw as to give a calculated travel of valve ¼ inch greater than is desired, and if the length of the rocker arms were given in this table and the valve travel calculated, it would appear as ¼ inch greater than the figures of the table. The actual travel is, however, confined to the desired amount by the limitation placed upon the throw of the reverse lever. With the exception of the 20 x 26 ten-wheeled freight engine, the length of the link between pin centers ranges between 2.2 and 2.3 times the throw of the eccentric. It will be seen that the velocity of the steam through the port is quite uniformly less in the case of freight engines than in passenger engines, owing to the fact that it is customary to use the same sized ports for a given cylinder, regardless of its duty, and the piston speed being lower in the freight engines, the velocity of the steam is less. There is sound reason in this, growing out of the fact that the terminal pressure in freight engines is higher than in passenger engines. The usual method for calculating the velocity of the steam is, in fact, defective, as it takes no account of the increased amount of steam contained in the cylinder at high terminal pressure over that contained at low. In a general way this is met by the practice described.

THE AREA OF THE PORTS.

One of the purposes of this table is, to make some comparisons between the port areas of stationary and locomotive engines. These will be found in the sixth, tenth and eleventh columns, and to the stationary engine designer will be the most interesting part of the table. Owing to the great variations in the speed of the same locomotive under different conditions, no exact comparison of this kind is possible. The speeds desired for this purpose are the average speeds, but who shall say what these are? Under these circumstances the only basis of comparison seems to be the schedule or time-card speed, and the speeds given in miles per hour are the time card speeds for which the engines are considered suitable, and it is from these that the piston speeds and steam velocities have been calculated. Of course the average running speeds must be greater than the time-card speeds, and the true velocities of the steam correspondingly greater, and while the port areas of the table seem small, they would seem smaller still could they be calculated from the true average running speed. The standard rule for stationary engine ports is, that the velocity of the exhaust steam, obtained by multiplying the piston speed by the ratio between the piston area and the passage area, shall not exceed 100 feet per second; whereas as will be seen by the tenth column of the table the velocity of the steam in locomotives is, for all large sizes, decidedly greater than this. The eleventh column of the table compares the actual passages employed in locomotives with those which the stationary engineer would give, and shows them, of course, to be much smaller, even on the basis of time-card speed. Could the calculations be made on the mean running speed, there is no doubt that the ports of most of the large passenger engines would be found to have less than one-half the cross-section commonly provided in stationary engines. It should be explained that in locomotive work, it is a common practice to make that portion of the passage which runs parallel with the cylinder ⅛ inch wider than that leading from the valve seat, as the inaccessibility of the first portion makes it impossible to clean it out or correct errors in the casting, while the second portion may be easily reached for that purpose. The portion of the passage, for which figures are given in the table, is the larger portion parallel with the cylinder.

PORT OPENING AND AREA OF NOZZLE.

If, however, these ports seem small, the openings of them to steam are still more so. Thus in the case of the 19 x 24 eight-wheeled passenger engine, the opening to steam at 8-inch cut-off is only 7-16 inch, and in the case of the 20 x 24 eight-

wheeled passenger engine, the opening is but ⅜ inch; these openings being in area but 39 per cent. and 31 per cent. of what would be required by the customary stationary engine rule, which requires the opening for steam to be three-fourths of the port given by the rule cited above.

Small as these ports seem, to a stationary-engine designer, it is, however, an open question if they are not larger than necessary or advisable. The point where the steam meets with the greatest resistance in its escape from the cylinder, is the blast nozzle. These nozzles were formerly made separate for each cylinder, the diameter of this pattern of nozzle for an 18 x 24 eight-wheel passenger engine ranging between 2⅞ inches and 3⅛ inches. Taking the mean of these, 3 inches, as the average, its area is but 2.8 per cent. of that of the piston, or but 35 per cent. of the area of the port. The port would naturally be made larger than the nozzle; but it would certainly seem that there is no occasion for so great a difference as these figures show. At present locomotives are more usually made with a single nozzle, through which the steam from both cylinders escapes, the diameters of these nozzles being about as shown in the following table, in which also their areas

BLAST NOZZLE AREAS, COMPARED WITH PISTON AND PORT AREAS.

SIZE AND CLASS OF ENGINE.	Diameters of Single Nozzles.			Area of Mean Size Nozzle as a % of Area of 2 Pistons.	Area of Mean Size Nozzle as a % of Area of 2 Ports.
18 x 24—8-Wheel Pass.	4¼	4½	4¾	.031	.4
19 x 24—8-Wheel Pass.	4¾	5	5¼	.035	.36
20 x 26—10-Wheel Frt	4¾	5	5¼	.031	.4
20 x 26—10-Wheel Pass.	5	5¼	5½	.034	.44
20 x 26—Consol. Frt.	4¾	5	5¼	.031	4

are compared with the combined areas of the two pistons and of the two ports. Of course a given area of nozzle arranged in this way gives less resistance than the same area in two separate nozzles, as the puff at release alternates between the cylinders; but, making all allowance for this, it will be seen that the resistance of the nozzle must be far in excess of that of the port.

SMALLER PORTS ADVOCATED.

In this connection, some remarks by Mr. Angus Sinclair, in "Locomotive Engineering" for April, 1897, are of great interest. Mr. Sinclair made use of his opportunities to measure the ports of several English locomotives, and found them to range between 10 and 13 inches in length, the width being about 1¼ inches, and Mr. Sinclair pertinently asks if the greatly increased clearance space due to the large ports of American locomotives is not at least partly responsible for the wastefulness of fuel with which they are commonly credited. In this connection Mr. Quereau's indicator cards, given in Fig. 1, are instructive. These cards were taken from an engine having its valve set to give a greatly reduced lead, as compared with ordinary practice, the result being to show clearly the termination of the compression line. Cards taken from engines having the valves set with the usual amount of lead, show the compression line running into the lead line in such a manner as to give the impression that the compression is continuous up to or even beyond boiler pressure, and the large clearance spaces heretofore used have been considered necessary to provide room for this compression. Mr. Quereau's cards show that the compression does not reach anywhere near boiler pressure, and that the clearance volume is not needed for this purpose, and in view of this, of the above comparison of nozzle and port areas and of English practice with smaller ports, it is at least a subject of doubt if American ports are not too large for the best results.

Experiments are now in progress on this subject, though not of a kind from which final conclusions can be reached. It, of course, involves some risk to equip an engine with cylinders having small ports, and the experiments are therefore being made with the usual size of ports reduced at the opening by a false valve seat. Inasmuch as the expected benefits of smaller ports would be due to the reduced clearance, which is not affected by the valve seat, it is clear that no conclusions can be drawn from such experiments regarding the real value of the change. The most that can be expected is ,to demonstrate that the smaller ports are not harmful, and perhaps thus lead to further experiment on correct lines. It would seem that any such change should be in the width, rather than the length, of the port. A change in the length affects both admission and exhaust, while a change in width affects the exhaust only. Injury and not improvement is to be anticipated from reduction of admission area, which should obviously be avoided.

Many years ago, Wilson Eddy, then master mechanic of the Boston & Albany Railroad, made many engines with small ports, even down to a length of 8 inches, and his conclusions were that the standard sizes of ports were too large. In this connection it must be remembered that back pressure is a very different factor in locomotives from what it is in stationary engines. With the latter it is an unmixed evil, but with the former it is a necessity. With stationary engines the boiler and the engine are practically independent structures; but in locomotives they are integral parts of the same machine, each reacting upon the other. The boiler not only supplies steam for the engine, but the engine, through its exhaust, supplies draft for the fire, and without the draft and the back pressure which produces it, the steam could not be made nor the engine operated.

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Possible Outlets for American Machinery.

Good authority is back of the statement that the directors of the Mexican Land, Navigation and Railway Company have announced their intention to begin work immediately on the construction of a railway to run from Paso del Rio de San Juan, in the State of Vera Cruz, to a point on the Tehuauntepec Railroad, and that they will place orders in the United States and England for the necessary material.

The attention of American manufacturers might be directed to various new enterprises under contemplation in Brazil; among them being the following: A system of waterworks in the Province of São Paulo, and of water or illumination in San Carlos de Pinhal, Rio Clara, Araraquera, Lenos, Brotas and Porto Ferreira.

In the city of São Paulo a water-meter of American invention is in general use, and most of the apparatus used in water, gas and electric lighting works has been furnished either by this country or England.

Changing the scene of prospective operations from South America to Africa, we learn that, up to the present time, no British firm manufacturing machinery has sent out a representative to Angola. At this point there is a fair demand for cane-crushing mills, steam engines and turbines. During the past four years one wideawake American firm has had a representative on the field three times, and good business has resulted from his efforts.

The British Vice-Consul at Loandes, writing to the Foreign Office in connection with this matter, states that our machinery is cheaper than that of British make. He also suggests that if a few English firms were to subscribe together and send a man to visit the Islands of Principe and S. Thome, and then proceed to Loanda, Benguella and Mossammedes, and thus get an insight into the requirements of these places, the results would more than repay the cost. If this suggestion applies to British firms, why may it not equally as well apply to manufacturers of our own country?

The imports of the Argentine Republic for the year 1896 were valued at $113,987,011, which was an increase of 17,000,000 piasters over those of 1895. This increase was principally in the importations of iron and manufactures thereof, the value being $4,517,620.

A good field for American capital and the enlargement of our trade may now be found in British Honduras, whose government is prepared to consider tenders from reliable companies, for the construction of a railroad to the Western frontier. The length of the road would be seventy-two

miles, and the government would be willing to grant concessions of land, with a bonus of money to aid the enterprise.

A concession has been granted to New York capitalists for the completion of an inter-oceanic railroad from Puerto Cortez to Amapala, Honduras. This syndicate is obligated to raise the foreign debt, has the right to establish a national bank, and has control of the custom houses of the Republic for a term of years. The syndicate is to put up certain guarantees in a short time. Washington capitalists have secured a concession for the construction of an electric railroad of the Fryer system, from Puerto Cortez to Truxillo. This concession is made to the "American Honduras Company," of Washington.

The suggestion is made that American manufacturers and exporters should unite and establish an agency at Guaymas, Mexico. The superiority and excellence of our American manufactures has been recognized, and whenever the goods are properly represented, the tendency is to purchase them; especially is this the case with shelf hardware, mining machinery and explosives.

The United States of Venezuela have changed their ministry, and with it there has been a change of tariff. As a result of this, iron ore and old iron, suitable for foundry purposes and windmills, both of which were formerly dutiable at 10 centimos per kilo, are now admitted free of duty.

Para, Brazil, is inviting bids for the purchase of the present waterworks of the city and for the extension of the system. Tenders will be received up to November 18th next.

A. F. TENNILLE.

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Notes on Rolling Mill Designing—II.

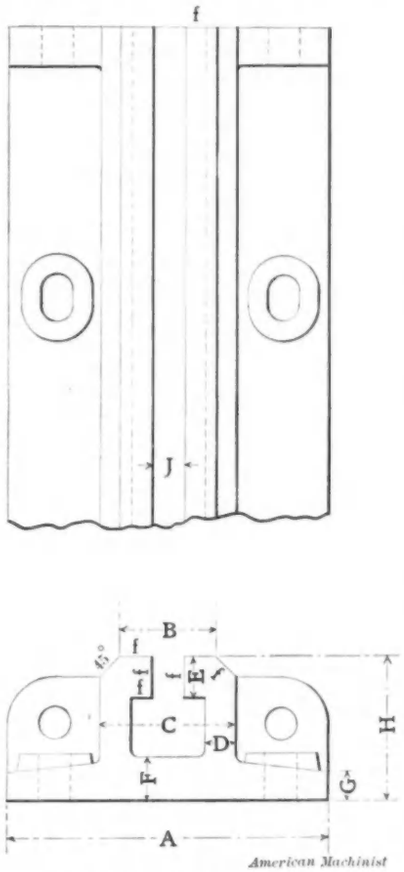
BY A. RANDOLPH.

Bar, Billet and Shape Mill Bedplates.

The unit for proportions is the pitch diameter of the rolls U, and the following table of proportions refer to letters on the drawing:

$A = U \times 1.06 + 1.5$.
$B = U \times .33$.
$C = U \times .5$.
$D = U \times .115$.
$E = U \times .15$.
$F = U \times .13$.
$G = U \times .09 + .25$.
$H = U \times .5$.
$J =$ To suit housing bolts.

The foundation bolts should be $U \times .075 + \frac{1}{4}$ inch, and the holes in the bedplate should be about $\frac{1}{4}$ inch larger than the bolts. The bedplate is made in lengths such as will bring the joints about the middle of the roll length or at the middle of a connecting spindle, so that the housing foot bolts do not come too near the joints. There are several different methods of uniting the bedplates at the joints, but the method shown is as good as any. The ends are slotted square, and the bolts made as large as there is room to turn the nuts with a strong wrench, the bolts being turned to fit the holes and serve as dowells to make the ends match fair. The foundation bolts should be placed about 4 feet apart along the bedplate, the first pair being 12 to 18 inches from the end or joint, and spaced equally between, but should not in any case exceed 5 feet apart. On account of the holes through the bedplate being slotted, a heavy wrought



ROLLING MILL BEDPLATE.

washer should be used under each nut. The anchor plate for each pair of bolts is in one piece, and should be of such strength that the bolt will break at the thread without cracking the plate. The area of anchor plate surface should be about $d^2 \times 150$, d being diameter of bolt. Foundations are usually built of hard brick laid in cement. The depth should be about 3 feet for an 8-inch mill, up to 6 feet for a 24-inch mill. They are frequently built with a tunnel under the center, with pockets under each anchor-plate, so a man can go in and get the cotter keys out of the foundation bolts. It is very convenient, in building the foundation, if anchor-plates are made with a downward projecting flange, so that the thickness at the edge is the same as the thickness of a brick.

All surfaces requiring a tool finish are marked f on the drawings.

Where the table of proportions gives results in inconvenient fractions, the nearest 1-16 inch may be used for sizes less than 1 inch, and the nearest $\frac{1}{8}$ inch for larger dimensions.

Salem, O.

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The Construction of Jigs for Drilling Holes in the End Rings of Armature Cores.

BY WM. BAXTER, JR.

As has been shown in the articles on the construction of armature cores, it is necessary that the sheet-iron blanks be accurately shaped, and that the rivet holes punched in them, as well as those drilled in the end rings, match each other perfectly; if not, the outside surface of the armature, as well as the faces of the grooves, will be so uneven as to require a considerable amount of dressing, which is objectionable, not only on account of the expense it involves, but also because it increases the liability of destroying the electrical insulation between the laminations. It is more important to have the rivet holes equally spaced, and all upon the same circular line, than for the blanks to be accurate in form. That this is true can be made apparent by the aid of Fig. 1. This figure represents a portion of a core built up of segments covering one-eighth of the circle. These segments are laid upon each other in brick-work fashion, so that the joints in one layer come opposite the center of the segments of the adjoining layers. If the teeth on the segments are spaced accurately, they will all match each other perfectly, providing the rivet holes also match and are in line with those in the end rings. If these holes do not match, it will be necessary for the rivets to be sufficiently slack to allow for the inequalities, and the result will be about as indicated in the cut, in which the top blank is shown in full lines and those immediately under it in broken lines. If the holes in the blanks are punched in one operation, by a double-punch die, as they should be, they will all be equally spaced; but if the holes in the end rings are not equidistant, the result will be, that where the spacing in the ring is wide, the blanks will be drawn apart, leaving an open joint at A, and causing the teeth to overlap as indicated by the full lines B and the broken ones C.

If the holes in the end rings are in their true position and the same distance apart as those in the blanks, both can be made to come in line, and then the rivets can be made to fit very closely. This being the case, the shifting out of place of the segments, and the consequent over-lapping of the teeth will be very slight, so slight as to render it unnecessary to dress out the grooves, providing they are made one or two hundredths of an inch wider than actually required to accommodate the wire and insulation. If the teeth are not

equally spaced, the effect will be that some will come in line, while others will not. Thus at *D* they might match perfectly, and be slightly out at *E* and *F*, coming into line again at *G*. This, although objectionable, would not be so much so as to have all the teeth out of line; therefore it is of more importance to secure accuracy in the spacing of the holes in the end rings, than in the shape of the blanks, and it may also be said that it is a result more difficult to attain.

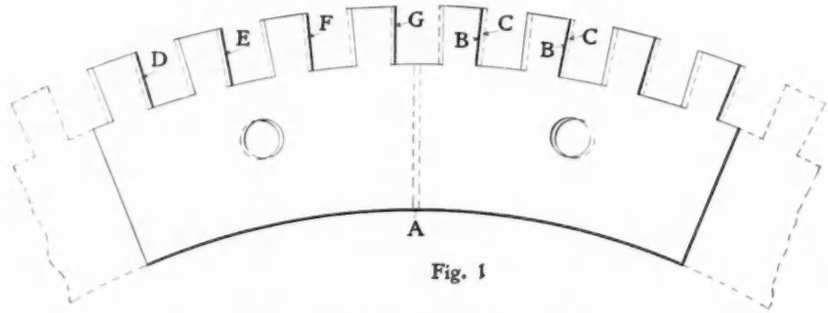

Fig. 1

RESULT OF INACCURATE SPACING.

There are many who would conclude that if the holes were spaced by means of an index, they would all be the same distance apart, and all on the same circular line. This would be true in theory, but in practice it would not, except under the most favorable conditions. If the index is in perfect condition, without lost motion in any of its joints, and the drill press is equally perfect, and provided with a chuck that will hold the drill central, and the drill is so short that it cannot spring, the holes will be very nearly equally spaced, but, in most cases, not so near as to render it impossible to detect the difference by placing two rings together and shifting them around to different positions. If in one position all the holes come in line, it is more than probable that in any other position they will not.

In order to obtain accurate spacing, it is necessary to drill the holes with a jig; but unless this jig is perfectly true, the work done with it will be defective. As has been shown, an index cannot be depended upon to give absolute accuracy in the spacing, and to obtain the result by carefully laying out the holes with a pair of dividers is practically impossible, no matter how skillful the workman may be. There is a simple expedient, however, by means of which extreme accuracy may be obtained, even if the workman is not specially skillful, and all it requires is a fair amount of patience. This method can be illustrated by the aid of Figs. 2 and 3.

If you take two pieces of sheet metal and drill three holes through them, making an effort to have the holes in line and the same distance apart, you can very easily convince yourself that you have failed in the attempt, by simply inserting a pin in the center hole and then reversing one of the plates. Fig. 3 shows the position of the holes in the reversed position, supposing the lack of accuracy consists in one of the holes being out of line, as shown at *A* in Fig. 2. If the holes are the same distance apart and only out of line, one pair may be made to match in the reversed position; but if they are not the same distance apart, neither one will match. If the plates are set so that the inequality is divided between the two holes, as shown in Fig. 3, and while firmly clamped in this position are reamed out until they match, it will be found upon reversing the plate again, that the lack of agreement will be much less than at first. If in the second position the plates are again clamped so as to split the difference between the two sides, and are reamed out for the second time, on the third reversal it will be found that the lack of agreement will be still less than on the second reversal. If the process is kept up, after a sufficient number of reversals the holes will come into perfect alignment. By this same process any number of holes can be equally spaced, whether in a straight line or upon a circle. In the construction of a jig for drilling the holes in the end rings of armature cores, proceed as follows:

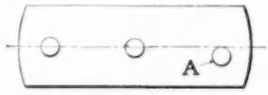

Fig. 2

Fig. 3

EQUAL SPACING OF THREE HOLES.

Make two rings to fit each other, as shown in Figs. 4 and 5, the latter being an enlarged section of the rings on the line *A A*. The ring *B* is made of the same internal diameter as the armature rings. The ring *C* will form the jig, and *B* is only used to bring the holes into their true position. Ring *C* should be cut away at *D* so that the armature rings, which when being drilled will occupy the position of *B*, may not be prevented from coming into position by the accumulation of dirt in the corner. The projection on the inner diameter of *C* should have the surface *E* slightly taper, so that the ring *B* may fit it perfectly, and at the same time be easily put on or removed. Lay out the holes on the upper side of *B*, and as accurately as possible, so as to save time and labor in the subsequent truing-up operation. The rings *B C* should be of equal thickness and as thin as the size of the holes to be drilled with the jig will permit, as the work of truing up will be reduced thereby. For small armatures the thickness of the rings may be not over ⅜ inch, but if the diameter is more than 15 or 16 inches, a greater thickness will be required to give the jig sufficient stiffness to insure it against being bent by rough usage. In very large jigs in which, for the purpose of stiffness, it becomes necessary to increase the thickness to over ¾ inch, the metal around the holes can be reduced by counter-boring, as the proper depth of hole through the bushing can be obtained by providing the latter with a thick flange.

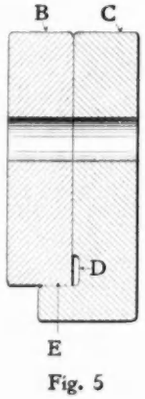

Fig. 5

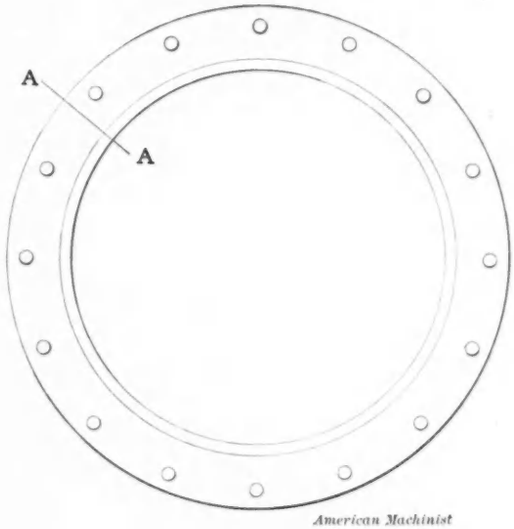

Fig. 4

EQUAL SPACING OF HOLES IN A RING JIG.

After the holes have been drilled, it will

be necessary to make a taper reamer and two pins, all of the same taper. If the holes come nearly true, the reamer may be short; but if the opposite is the case, it will have to be long. Generally, if the holes have been drilled, say, ¼ inch in diameter, the reamer will have to be about 5 inches long on the cutting edge, and run from a little less than ¼ at the small end, to ⅜ at the large end. The pin and reamer must be ground to the same taper after being tempered.

The holes in the rings will only match each other when the rings are put together in the position in which they were

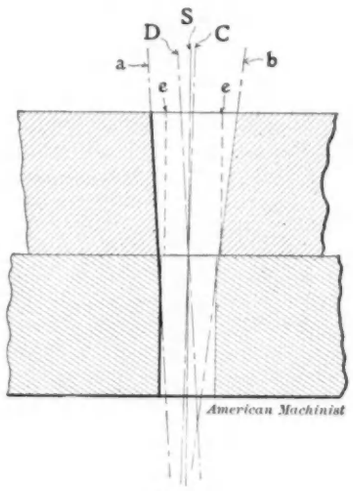

Fig. 6

WHY THE REAMER STRAIGHTENS ITSELF.

drilled. If *B* is turned to the right one hole, very few of the holes will come in line. To make them come in line, proceed as follows: Place the rings so that one pair of holes are in line, then clamp them firmly together with five or six strong screw clamps. Run the reamer into the hole that is in line until it cuts through ring *B* and just enters *C*. Drive one of the pins into this hole, and then ream out in the same manner a hole on the opposite side of the diameter. Place the other pin in this hole. These two pins, together with the clamps, will render it impossible for the rings to shift their position. Proceed now to ream out all the holes, working the reamer the same distance into every hole, so that they may all be of the same diameter at the surface of contact of the two rings. It may be that some of the holes will be so far out of line that the reamer will have to be run in further than in the first hole, to take a cut all the way around the upper edge of the hole in ring *C*. If this should be the case, it will be necessary to go over the holes first reamed, and make them the same size. Having reamed all the holes, take out the pins, loosen the clamps and shift ring *B* one more hole ahead, and repeat the operation of reaming all the holes.

If this process is continued long enough, it will be found that the holes will come into perfect alignment. If the holes are drilled with fair accuracy in the first instance, it will not be necessary to shift the rings more than six or eight times to bring them in line. If the holes are brought into line before the reamer has been worked all the way through ring *C*, it will be necessary to continue the operation. It will not answer, however, to run the reamer all the way through *C* while the rings are in one position, even though the holes may have been brought into perfect alignment, because there are liable to be hard spots in the iron that would throw the reamer to one side; therefore the process of shifting the position of the rings must be kept up, and in each position only a small portion of the metal must be removed.

After the reamer has been worked all the way through ring *C*, a counter-bore is to be made, the end of which will fit the lower side of the hole in *C*. This counter-bore will only be guided by the small surface of contact at the lower side of *C*, but that will be sufficient, if it is well fitted and used with proper care. If it is desired to guard against all possibility of spoiling the work by the working loose of the end of the counter-bore, the reamer used to true the holes can be made with the upper end parallel, and can be worked all the way through the holes; then they will not be taper, and the counter-bore can fit the holes from top to bottom.

In reaming out the holes it is not necessary to pay any attention to the direction in which the reamer is running, as it will square itself as the work progresses. This will appear quite evident from a consideration of Fig. 6. If the hole in the upper ring is to the right of that in the lower one, the reamer will incline to the right, as shown by the line *C*, *S* being the true center line square with the surface of the rings. When the ring *B* is shifted, the holes that come together will not be out of line in the same direction as before, therefore the center of the reamer will assume another direction, as indicated by the line *D*. The next time the ring is shifted, the relative position of the holes will change again, and the direction of the reamer will also change; but each time it will come nearer to the position of line *S*, and finally will reach that position.

To secure perfectly accurate results with this process, all that is necessary is, to clamp the rings well and drive the pins in tight, so as to prevent shifting, and, in addition, to work the reamer into all the holes the same distance at each operation. This being done, patience does the rest, and a bright apprentice boy will obtain as good results as the best tool-maker.

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The one hundredth birthday of the U. S. frigate Constellation was celebrated at Newport, R. I., on Sept. 7th. The timber of the old ship have been entirely changed several times.

A New Water Gage.

The illustration shows a recently patented water gage for steam boilers which shows some interesting points. *A* is the front of a boiler, and the vessel *B* is connected to it by the steam passage *a* and the water passage *b*. The float *c* has a hollow stem which passes freely up through the top of the vessel *B* into the

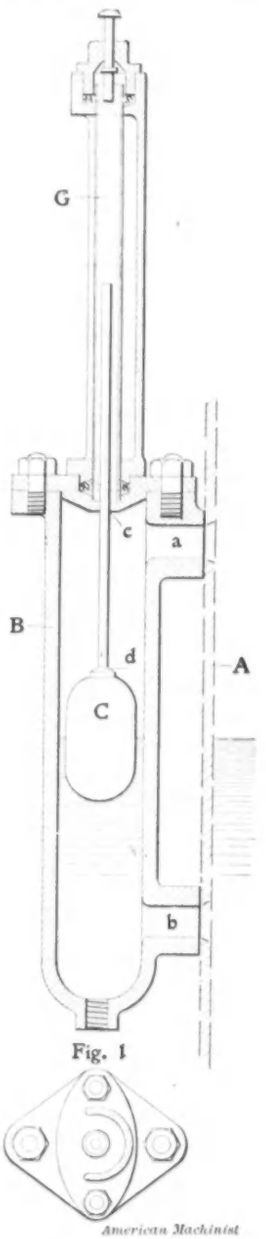

Fig. 1

Fig. 2

A NEW WATER GAGE.

glass tube *G*. The stem of the float is preferably hollow, with a little side opening near the lower end, so that the steam may pass up through the stem and fill the gage glass, while the water of condensation can return down through the opening *c* through which the stem passes. If the glass breaks, the pressure within the vessel *B* will cause the float to rise and the valve face *d* will close the aperture *c* and

stop the escape of steam. After the glass is replaced, the starter *I* may be used to push the float down sufficient to uncover the little steam passage in the stem, when the pressure will be equalized in the glass and in the vessel below it, and the float will at once resume its normal position and function. The top of the float stem visible through the glass will always show the hight of the water in the boiler.

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Caught by a Belt.

A horrible accident occurred in this city on September 3d, in the station of the Edison Electric Illuminating Company, on East Twelfth street. Electricity, in this case, was not directly the cause of the catastrophe. Two brothers, tinsmiths, were soldering the covering of a platform between the fly-wheels of two high-speed engines belted to dynamos. The space was narrow, and the work, done on hands and knees, was very fatiguing. When near quitting time—6 o'clock—William Jessup for a moment raised his arms to stretch himself, by way of relief, when his coat or some part of his clothing caught between belt and pulley, and he was whirled to instant death. There is no necessity for such risks, and no excuse for such accidents, and the blame for them does not lie with the men whose circumstances compel them to accept work under such dangerous conditions.

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Skimming Castings.

BY R. D. MOORE.

In these days of highly polished machinery, the making of clean castings becomes one of the most useful points in the molder's art. Many molders do not understand the principle of skimming metal effectually in the process of pouring castings, or, in other words, constructing a skim gate that will separate the dross from the pure metal in passing through it into the mold.

The construction of gates having such properties is extremely simple when the principle on which they work is once understood, and they can be varied to suit almost any room or circumstance.

The process of skimming is simply passing the melted metal through a chamber long enough, wide enough and high enough, and consequently slow enough, to give time for the lighter dross to separate from the heavier metal by rising above it, and staying there. This separation takes place very rapidly if the metal is as hot as it should be for finished castings.

A plain block, 2½ inches wide, 2½ inches high, by 4 inches long, set against the pouring gate in the cope, makes a good skimming chamber for a 100-pound casting.

Fig. 1 shows a similar gate, the chamber chopped out, with a trowel, to the dotted lines; but when to be used often, a much better practice is, to make a pattern, notching out one end to fit the gate stick. A pattern keeps the gaggers in their place, out of the way, and saves time. I used this gate successfully fifty years ago on engine and other finished castings.

Some years ago a double gate—two small gates, set 3 or 4 inches apart—was generally adopted as a skimmer; a small sprue running under the second gate be-

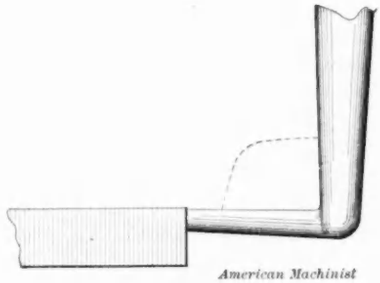

Fig. 1

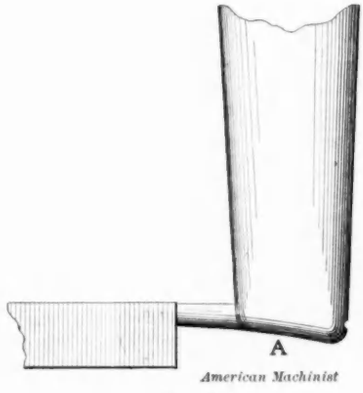

Fig. 2

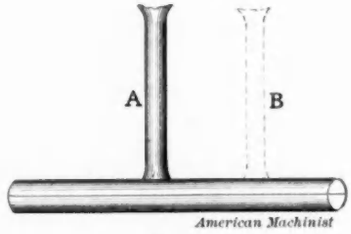

Fig. 3

ing supposed to land all the dross in that small opening "quick as lightning"; but Nature don't work that way. All fluids in their passage through a pipe have their surface movements retarded by friction, which converts them into a series of revolving collars, as seen at the escape pipe of an engine. That operation may be called a good mixer; but for skimming fluid metal we need a good separator, a more placid passage, as through Lake Ontario, rather than Niagara's whirlpool. That double gate was, in a measure, a success; but the skimming was really accomplished by fast pouring, keeping the first gate very full, and floating the dross at the top.

A good improvement on that double gate is the later practice of slicing out a chamber between the two gates; but the form shown at Fig. 1 takes less room, and does equally good work.

Fig. 2 presents a skimming gate with many good features. Among them is its simplicity of construction, taking no more time than a common pouring gate; its economy of room, requiring very little more than the ordinary pouring gate, and consequently its convenient application to a great variety of molds. It should be made with a smooth gate stick, running straight to the bottom, without a point. If a steady pin is wanted, a small cone print nailed on bottom end, is good practice.

The principal feature of this gate is its increased diameter, giving room for the dross to rise while the stream of iron is descending; the sprue being small for slow pouring. For running a 100-pound steam-chest cover, a broken-off piece of which is shown, 2½ or 3 inches are suitable sizes for gates.

Attention is called to the shape of the bottom of the sprue *A*, where the first dash of metal strikes. The slope backwards will cause the first metal to dodge away from the running sprue, carrying any dirt that it is apt to pick up, with it. That shape, carefully made, will add to the perfection of the skim.

Another skimming trick, and a very economical one, when there is room in the flask to throw away, and which I have used for fifty years, consists in running the metal through another rough casting; pillow blocks, engine bed washers, breaking bridges for roll trains, etc., may be named as examples. I have made many engine rock shafts that were afterwards finely finished by running through a 5 by 10-inch bed washer; even that simple flat mold holding back the dross surprisingly.

I, some years ago, made a lot of brass plungers for paper-mill "stuff" pumps, about 5 inches diameter and 20 inches long, cast horizontal, and they were absolutely perfect after tooling. They were poured through a skim gate made by molding a gate stick 1⅛ by 7 inches long, alongside, at the parting, running the metal in at one end and out 1 inch from the other end into the casting.

I have cast, in the last eighteen years, a large number of engine cylinders with this kind of skimming device, as shown in Fig. 3. It pays to make a split pattern, 2½ to 3 inches diameter, two or more inches longer than the shortest cylinder; then, for longer jobs, make a short piece of pattern to match. A pouring sprue is cut into each drag flange just large enough to run the job, for good skimming. A

pouring gate is set on the middle, as shown at *A*, giving the dross ample time to rise before reaching the end. The fall is sufficient to break the bottom of this gate, and should be fortified by many nails, leaving the heads even, to resist the first drop of iron. I have been using an extra rise-gate, shown by dotted lines. Fig. 3, at *B*, to regulate the speed of pouring.

One interesting fact that has escaped general notice is, that a piece of slag, glassy substance, the size of a pin-head, will give off gas and form a cavity the size of a pea, or even a marble, in a casting.

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Specification of Error Limits for Machine Tool Construction.

BY A. A. FULLER.

Builders with experience on contract work know the value of clear and concise specifications. Bridge builders have standard sets of specifications for various kinds of bridge construction. It is not sufficient that the design be correct and the materials of given strength, but the workmanship must be of a specified quality in order that no undue strains be produced during its erection. So in machine tools, although the design be excellent and the materials of construction well chosen, poor workmanship may cause the tool to be worthless for the use desired. Why not, then, specify the quality of workmanship? In all kinds of work specifications prohibit misunderstandings, and protect both buyer and seller.

The general design of a machine tool is usually obtainable either from observation of the tool itself or from a study of its drawings. The materials of construction are specified by name, composition and tests. The workmanship can be described by such adjectives as first class, perfect, good, best of its kind, excellent, etc.—terms which never mean the same thing to any two persons—or it may be specified by arithmetical and geometrical terms, the meaning of which are beyond question. Is it not rather strange that such terms have not before been generally embodied in the specifications for our machine tools? Is it not time for us to discard ambiguous and adopt specific terms for quality of workmanship?

The most progressive of our tool-builders do know the error limits of their tools, and have lists specifying the errors allowable in the finished product. Other builders may build as accurately by attempting to work to absolute gages, but the real degree of accuracy depends upon the judgment and touch of the workman and foreman. For a small shop such a method may be safe, but for a factory it is dangerous. Where duplicate and interchangeable parts are required, limits are indispensable, and are most often determined by experience. Where only a single machine is to be built, error limits are a great help in construction, and a practical designer or master mechanic can, with a little patience, establish such limits before the work is begun.

In answer to the question, "What are the error limits on a 16-inch tool-room lathe?" the questioner need only turn to the "American Machinist" of August 11, 1892, which publishes the limits of the Brown & Sharpe Manufacturing Company, who make 13 and 16 inch tool-room lathes as shown by their catalog. Their actual errors in practice are often only one-half or one-quarter of those error limits. Their lathe beds are hung on three points, so that they *will* retain the same error limits, even if moved from place to place.

Mr. Randol's limit list for the 60-inch lathe contains two errors. The limit in test No. 3 should read, .001 inch (instead of .0001 inch); and No. 4 should read, foot stock spindle to line with head stock spindle (instead of foot stock spindle to line with ways of bed).

At the Builders Iron Foundry there are one 12-inch, three 14-inch and three 16-inch Hendey Norton regular commercial lathes, six lathes, every one within the Brown & Sharpe limits, and regular 21, 24 and 27 inch Fitchburg lathes, also within their limits. There are doubtless many other makers who build, perhaps without knowing it, as accurately as the foregoing, but these have come under the writer's personal observation.

As to the other machine tools mentioned, the same holds true. Any first-class shaper or slotter made by a reputable builder will produce work accurate within .001 or .002 inch within their scope. Even the much abused drill presses of the best makers have their spindles perpendicular to their tables within a limit of .005 to .010 inch per foot.

As for planers, there are many that will not make the finger of a Bath indicator show more than .002 inch in the full travel of the table. Just think of it a moment. How could it, with the table freshly faced off? Even the large 10 x 10-foot planer in the Pond shops will plane a lathe-bed so that it will show true to a 10-foot straight-edge within .001 inch in 10 feet. This same planer also does a remarkable thing, perhaps by mere accident. The side head on the housing planes a vertical surface square with a horizontal surface planed by a head traversing the cross-rail within less than .001 inch in 3 feet.

A recent Bement, Miles & Co. cylinder-boring machine, 35 inches from center of bar to bed, now in the shops of the Builders Iron Foundry, will bore cylinders 6 feet long, 16 to 30 inches or more in diameter, true within .001 to .002 inch for diameters and straightness, and face up ends parallel within .001 inch in 12 inches. The Builders Iron Foundry also have a port boring machine, of their own make, which will bore irregularly ported cylindrical Corliss valve seats within a limit of .002 inch for diameters and straightness, and counter-bores the seats for the bonnets square within .001 inch in 12 inches.

Data of this kind are of great service in determining definitely what to expect of first-class tools. It helps to dispel the gloom from such seemingly dark statements as, "our tools have abundance of errors all over," and "that the indicator will not stand still by a *long* way," etc. It also aids us in determining error limits for other large work which introduces the question as to limits on large lathes.

For work of the same class the limits on large lathes should not be proportioned to the sizes of the lathes. It will be noted in the cases of the 12 to 27-inch lathes already cited that the limits were the same. Had they been as 12 to 27, the 27-inch lathe would not have been fit to produce the fine work it has been called upon to do. When you have a drum to turn particularly true and smooth, without a chatter mark, do you look around for the smallest lathe it will go into? Or do you look for a large one with a good-sized spindle, good stiff centers, bed and carriage? And when you find the large lathe, do you want it any less true and accurate than the smaller one? Many parts of our smaller tools are made on our larger ones, and were our larger ones less accurate, our smaller ones would be likewise. Our indicators, our surface gages and straight-edges can as easily determine that same .001 or .002 inch in the large lathe as in the small lathe. If the machine work on a large lathe is carefully done, the remaining errors may be remedied by an amount of hand work and fitting fairly proportional to the total amount of work expended on the lathe.

Mr. Randol recognizes in general that a tool must be adapted to its work. The quality of the product being specified by error limits, the only practical way of insuring that this quality can be produced by a tool, is to determine by inspection and experience the allowable error limit in the tool, and to have the tool built and lined up within those limits. A lathe ordered without specifications might do as accurate work as one built with specified limits. If it should, would it not be simply by accident? Should a good manager allow himself to be drawn into this lottery of accident?

The government limit on a built-up gun for turning the exterior surfaces and for boring the interior of tubes, jackets and hoops, preparatory to shrinkage operations, is .003 inch on diameter. These surfaces are often long, and require accuracy in spindle, bed and carriage. The bores of the mortars must be between 12 and 12.003 inches diameter, and must be straight enough to allow a test plug 11.997 inches diameter and 42 inches long to slide through easily. This requires accurate alignment. In the breech of the gun is a breech-bushing which is screwed into the gun on a taper thread. This thread resembles a square thread, but the

sides of the thread are tapered about 10 degrees. The thread on the exterior of this tapered bushing must touch all over top, bottom and sides on the tapered interior thread cut in the gun to receive it, and at the same time the end of the bushing must bring up against a shoulder in the gun. Bushing is 20 inches diameter, and threaded for about 15 inches. This requires an accurate lead screw and taper attachment. In the face of such requirements, were not the limits specified for the Providence lathe well chosen?

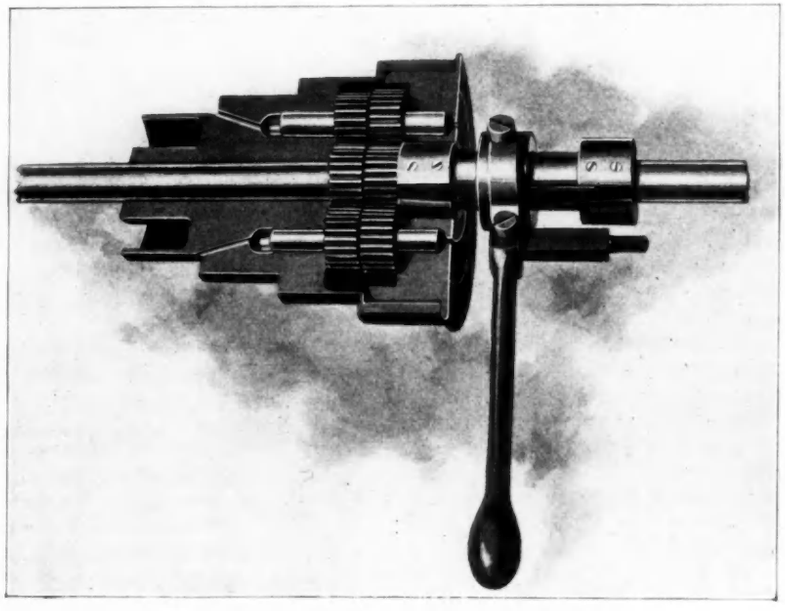
The general limit of .0025 inch, said to have been specified for the gun lathes at the Watervliet Arsenal, are not so different from those used by the Builders Iron Foundry, except in a few essential points, and there they fail utterly. For instance, take test No. 1, and apply the limit of .0025 inch to spindle running out. The government specification for boring and turning shrinkage surfaces is .003 inch, as before stated; so that a lathe built with this error would only leave .0005 inch leeway for the workman and variations of temperature. In gun-making, the difference of temperature between the heavy pieces and the standard measuring bars or vernier which assume the shop temperature readily, often amounts to .0005 inch.

In answer to the queries in regard to the action of the face-plate, spindle and lathe bed when loaded, the following are facts: With the heaviest end of a 14½-ton mortar swung in a chuck on the face-plate, and the other end turning in a steady rest, the Builders Iron Foundry lathe has been for months, and is still, boring the finished 12-inch hole in the mortars under manufacture so straight that the axis of the bored hole, 8 feet 6 inches long, does not depart .002 inch from the axis of revolution of the mortar anywhere in its entire length. One of the latest bores shows a departure from the true axis of less than .001 inch, indicating that the lathe is still in its original alignment.

The demand of the times is, workmanship adapted to the class of work in hand. Some of this work needs to be done within one-eighth of an inch, some within the "half of a sixty-fourth" of olden times, some needs to be done within one or two thousandths, and some must be done within two or three ten-thousandths. If we must thus discriminate between degrees of accuracy, is there any better way than by actual measurement? The steady growth of the micrometer, vernier and steel-scale business, would seem to clinch the fact that we are advancing into a day of surer mechanical excellence. The habit of speaking exactly and a knowledge of what constitutes a good and poor fit between two pieces are of such primary importance, that we shall never return to the age of questionable adjectives, or to a dependence upon the knowledge and skill of the one workman who "knows how."

Improved "Planetary" Gearing.

We illustrate herewith a recent application of "planetary" gearing for the purpose of driving a shaft at two different speeds from a single driver. Referring to Fig. 1, the shaft, it will be seen, has a bearing at each end in the bracket or standard. The gear 2 is keyed to the shaft. This gear has a long hub extending to the face of the left-hand bearing and upon this hub one side of the box pulley 5 is fitted to turn freely. Gear 3 is loose on the shaft and has a still longer hub or sleeve extending to the face of the right-hand bearing. The other side of the driving pulley fits loosely on this sleeve. The sleeve also carries two split collars 13 and 16, which are held in place longitudinally and also secured to turn with the sleeve by the screws shown. When the collars are unexpanded they fit loosely in the hoods which overhang them. One of these hoods is a part of the driving pulley and the other is a part of or fastened to the right-hand bearing. The sliding clutch collar has projecting from it, longitudinally of the shaft, two wedges, one on each side, extending into a cut in one of the collars. If the clutch collar and wedge is thrown to the left, collar 13 is expanded and the pulley turns with the sleeve. If the clutch collar is thrown to the right, the sleeve is held fast and the pulley turns freely on the sleeve. It is to be remebered that when the sleeve is thus secured from turning the gear 3 is also stationary. The box pulley has mounted within it two similar shafts, 6 and 11, and upon each of the shafts are keyed two gears, 7 and 8, one meshing into gear 2 and the other into gear 3. Supposing the clutch to be thrown to the right



"PLANETARY" BACK GEARS FOR LATHE.

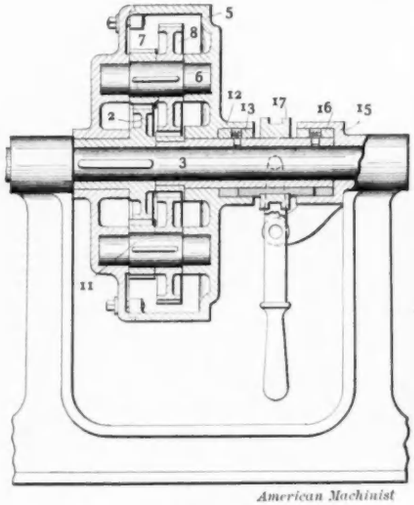
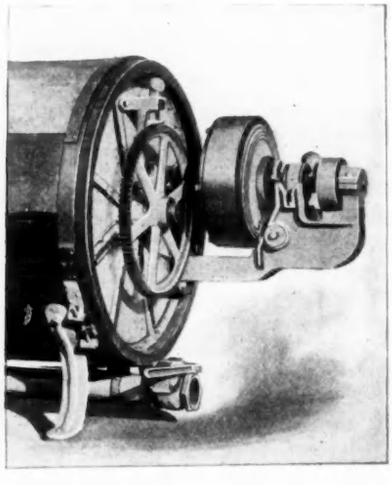


Fig. 1

SECTION OF "PLANETARY" GEARS.



"PLANETARY" REVERSING MACHINE.

and gear 3 to be held from turning, the shaft will be driven only by the action of the gearing, but if the clutch is thrown to the left, causing the long sleeve and gear 3 to turn with the pulley, no action of the gear train will take place and the shaft will turn at the same speed as the pulley. With the clutch thrown to the right and the gearing in action, the speed will depend upon the relative sizes of the gears. With the gears as shown the shaft will turn in the same direction as the pulley, but at a considerably reduced speed. If all the gears had the same number of teeth the shaft would remain stationary while the pulley revolved. If gear 3 had more teeth than 8, and 7 had more teeth than 2, the shaft would turn in the opposite direction to the revolution of the pulley.

Fig. 2 shows a proposed application of the device for "back gearing" a lathe or drill, and Fig. 3 shows an actual application of it in driving a washing machine, an automatic intermittent clutch action effecting the periodical changes of rotation. This device is the invention of W. S. Rogers, superintendent American Laundry Machine Co., Cincinnati, Ohio.

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Letters from Practical Men.

Fire Pails in a Foundry.

Editor American Machinist:

I do not know how they would manage it in a foundry, never having been in one for more than fifteen minutes at a time; but I am quite sure that, in any machine shop, the man in whose possession a fire pail was found would be the one held answerable for its absence from the shelf, regardless of the question, Who took it down? If the molder's duties do not compel him to leave his "floor," thus giving his neighbors a chance to shy their pails thither, I do not see why the same plan should not work in the foundry. It would have the great advantage of throwing the burden of enforcing the rules on the men themselves.

If the fire pails are abstracted for legitimate use (a not impossible supposition, if I may judge by what I have seen), it would seem a first-rate idea to provide more every-day pails, or ampler washing accommodations, if they are used for the latter purpose. It is a poor plan to try to teach men to be dirty.

HERBERT L. TOWLE.

New Haven, Conn.

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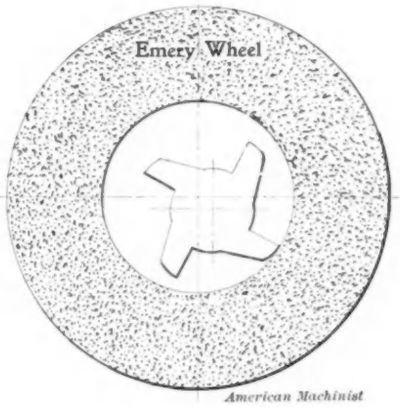
New Way of Backing Off Reamers.

Editor American Machinist:

In regard to that reamer grinder that Mr. Frank Richards wants, I wish to suggest a way out of his trouble that seems practical to me, but I have never tried it. I inclose a sketch of reamer and emery wheel. I would first grind reamer to size on any universal grinder. To back it off I would use an emery wheel having a hole in the center, somewhat larger than the outside diameter of the reamer to be backed off. By applying the internal circular surface of the wheel to each flute of the reamer in succession, almost any desired shape could be obtained. And by making a few attachments for the universal grinder, this machine can also be



REAMER GRINDING.

used for backing off, as well as when it was done by the old process of applying the external surface of the emery wheel to the reamer.

D. C. D. WHITCOMB.

Chicago, Ill.

[Some practical difficulties will immediately suggest themselves in this plan, but probably they are not insurmountable. If there is no better way of doing it such a wheel as our correspondent sketches could be driven in a fixture similar to those used for driving bicycle pedals when both bearings are ground simultaneously, and the advantage of grinding in this way is obvious—in fact has been already demonstrated.—Ed.]

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A Suggestion in Tap and Die Making.

Editor American Machinist:

More than twenty years ago a prominent Hartford tool company contracted to equip the Prussian Government armories with machinery, tools, etc., to manufacture the Mauser gun, the barrel of which was secured in the receiver by a screw thread. Machines were designed and constructed to taper the thread in the receiver, but on trial it was found somewhat difficult to make a smooth and accurate thread therein, and have barrels and receivers interchange without partially redesigning the model-gun, which latter, of course, was not allowable.

Several sets of specially designed taps were made and tested by as many of the shop-experts, but all more or less unsatisfactory. Finally, Mr. M. C. Johnson "tackled" the problem and solved it with taps made like the one recently patented by Mr. Echols, as illustrated and described in your September 2d edition, and which worked so well that sets of them were made for and sent with the machines.

Mr. Johnson informed the writer that similarly constructed taps had been used by him a few years previously in a New Bedford shop tapping out the jaw-covering shells of the well known Beach drill-chuck.

Moral—if there be any:

"There's nothing new beneath the sun!"
Hence sometimes we espy,
Inventions patented too late;
Things that we think quite "up to date,"
Of novelty are "shy."

CHAS. E. CHURCH.

Norwich, Conn.

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Brains in the Machinist's Trade.

Editor American Machinist:

Your recent editorial on this topic, called out by the elegant methods of Mr. Cleaves, was not only deserved by those devices, but is an excellent sketch of the most characteristic feature of the machinist's trade. Many trades could be named which, so far as pure manual skill is concerned, require greater dexterity than that of the machinist; but in the amount of brains involved in his work, the machinist is superior to any other mechanic.

From the old-time machinist of the jobbing shop, whose praises Chordal used to sing so well, to the most up-to-date toolmaker of the highly organized factory shop, each day's work involves a constant scheming of methods for doing work, to a degree found in no other calling. The molder's trade approaches the machinist's in this respect, though, according to a recent contributor to your columns, the "average molder don't know" this to a degree that will hurt; but, with this exception, I know of no trade which approaches so high an intellectual plane as the one which you especially represent.

This fact cannot be too strongly insisted upon. Properly appreciated, it should do much to increase the machinist's self-respect, with all that that involves.

C. O. GRIFFIN.

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Piston-Rod Fits in Pistons and Crossheads.

Editor American Machinist:

In general, a taper fit comes nearer being a necessity on the crosshead end of a piston rod of an engine than in any other place I know of, that is larger than those usually made with reamers, such as lathe centers and pins for planer aprons. I do not see any objection to straight fits for crank pins, rocker pins, etc., whether for engines or when they fill a like office in other machinery, when they are either pressed or shrunk in. The press has, of course, the preference in most cases. It

is necessary that a crank pin should be tight in the crank, and pins that are equally tight will be equally hard to start out, whether a straight or taper fit, unless the taper is excessive. Therefore, so far as taking out is concerned, the taper has but little advantage over the straight fit. If a straight pin has been put in, I do not see the necessity of riveting it over on the back, nor of having a collar on the front

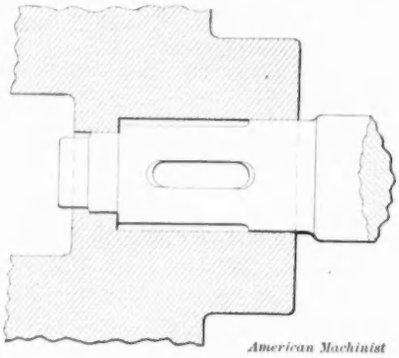

Fig. 1

of the journal if the pin is smaller than the hole in the crank, and the rod box flush with the face of the crank. The biggest job in taking a straight-fit pin out is often in chipping the rivet off on the back; while a small hole drilled and tapped, partly in the pin and partly in the crank, and plugged, answers every purpose, and is much more readily removed than a rivet around the pin, when a new

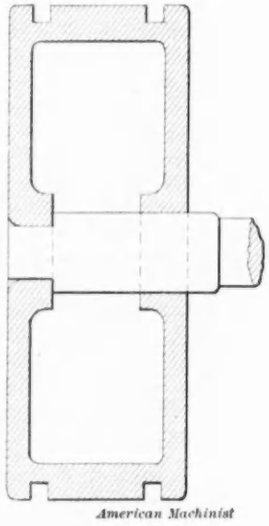

Fig. 2
PISTON-ROD FITS.

pin is required. There is, in some respects, an analogy between a car axle and a crank pin, especially in the relationship of the wheel to the axle and the crank to the pin. Both are subject to hot boxes and pounding, and if either come loose, from a little every-day trouble to a disaster may be the result. The wheels are pressed on the axles and depend alone on the friction between the surfaces to hold them there. Then, why not trust crank pins, when the conditions are more favorable to them (for they are better fitted) without collars or rivets?

I enclose sketches of straight fits for pistons and crossheads that are "O. K.," so far as I can see, and are not expensive or difficult to make. I make pistons as large as 10 inches, as shown in Fig. 2. There are no ribs cast in the heads, but are in larger sizes, and the hub also extends clear through the head; the cores being taken out through the sides, and the holes afterward plugged up. In the small sizes the rods are shrunk in, and the larger, pressed in. For heads over 20 inches diameter I recess the head and put on a nut, instead of riveting, as shown in Fig. 2; but in all sizes make the shoulder on the rod near the end. In regard to the shoulders on the rod, I make the crosshead end the same as the piston. For a length equal to about one-fourth of the diameter of the rod, at each end of the crosshead, the rod is turned to a light driving fit. What is left is relieved so that it will slide in freely, as shown, but much exaggerated, in Fig. 1.

J. H. DUNBAR.

Youngstown, O.

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The Heilman Locomotive.

Editor American Machinist:

I suppose you know something about the Heilman locomotive. It strikes me as electricity gone daft. That is the most natural kind of a remark for an average mechanic to make about it, when he gets onto the idea. We are all more or less familiar with power transmission under different conditions. The power is running to waste or is generated at one place, and we want to use it at another. That is where the transmission comes in. Common means of power transmission are the hydraulic, the pneumatic and the electric. They have each been advantageously applied in various ways. Various other ways have been thought of, and wisely abandoned by the thinkers as impracticable. Some of them which should have been adandoned have actually got into construction first, only to come to destruction soon afterwards.

The transmission or conversion of power, of course, means loss. Whatever system is used, the nearer we are to the source of power the better we are off, other things being equal. If we can't bring our work to the water power, for instance, why not bring the water power to the work? Driving our cars on the railroads is the use of power that seems to trouble us most of anything. Possibly some wiseacre may have woke up some morning with a concertina headache, and with a scheme for getting rid of the loss in transmission by mounting a steam boiler on a car, the steam to drive a pump, the water from the pump to drive a water-wheel, and the water-wheel to turn the car axles and make the whole thing go. That would be an entirely self-contained system, all being mounted on the car, and there would be little or no loss in power transmission. I have, however, never heard of this scheme being proposed or mentioned before.

It might also be possible for a fellow, inflated with compressed air, to propose a similar steam boiler on a car with an air compressor and an air motor, first compressing the air on the car and then using it in the motor—the latter, of course, driving the car. This scheme, also, we never knew to be actually tried, or even proposed. I did, however, know of one compressed-air scheme not much more absurd, and had to do with furnishing the air compressor to operate it. In this scheme the compressed air at high pressure was stored on the car in suitable tanks, and in what was assumed to be sufficient quantity. There were then provided two other tanks of considerable size, one, at the start, full of oil, and the other empty, and between them a liquid motor connected to the axles to drive the car. The air pressure was applied on top of the oil, and then the oil under pressure was to drive the motor and the car; the exhaust oil flowing into the second tank. When the second tank was full and the first one was empty, the air pressure was switched to the other tank, the flow of oil was reversed and the car went on. This scheme was actually worked up and tried.

Neither of these schemes is so absurd or impossible, when we stand in the presence of the third one. This is, to have our steam boiler on the car, as before, the steam to drive a dynamo, the current generated to drive an electric motor, and the motor to drive the car, the same as with any trolley car of the day. This cannot be as absurd as it looks, because this is the Heilman locomotive. It has not only been made and tried, but a second and a third one have been made.

The Heilman electric locomotive is a French invention, or, rather, the inventor is a Swiss, while the invention has been developed in France. The best resources of modern engineering have been availed of in the design, and, as a whole, it is a very creditable presentation of what, to me, seems to be, after all, an utterly impracticable idea. The boiler is a good one; the engine is a Willans compound six-crank vertical engine. The supreme claim made for the engine is that everything is balanced, and that it must run smoother, especially at high speeds, than any locomotive ever before built, and must be much easier on the road-bed. There are, it seems to me, some practicable suggestions that may be made right in this line. It won't do to say anything about them to railroad men. I know how that thing works. You must only suggest the minutest possible improvements on the present locomotive, and even

that is not very safe. With a few more dainty touches here and there, the locomotive is perfect, and those touches, of course, should be given by those who have done all the rest of the picture.

That is all right, but I keep thinking about how much the bicycle folks have taught us all around on the general subject of locomotion, and I would not be surprised any day to see the locomotive people taking radical lessons from them about building locomotives. There is much that might be learned and adopted about the use of tubing, and why not, also, about the use of the chain? We have all of us vastly more respect for the chain as a power transmitter than we had ten years or twenty years ago. It is entirely practicable to-day to build a locomotive with high speed, perfectly balanced, smooth running and economical engines, and chain transmission to all the axles, and I expect to see it. With the electrical people so evidently intent upon swallowing everything in sight, it can scarcely be pretended that the time-honored old locomotive is as safe as it once was, and there was never a time when revolutionary suggestions were more permissible than now.

TECUMSEH SWIFT.

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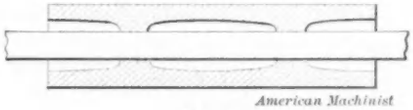
Long Break-Rolls.

Editor American Machinist:

In a shop in Loebtan, near Dresden, there are chilled iron break rolls for new process flour mills, of twice the length usually employed. I thought at first that they were "pony" paper-calendar rolls. A very ingenious method is adopted of preventing their natural expansion in length during work, from causing buckling in the middle and hence unequal grinding, as is often the case, even with ordinary rolls for the same purpose. As usually

Fig. 1



American Machinist

Fig. 2

LONG BREAK-ROLLS.

mounted, the rolls are held at each end to the shaft or arbor, as seen in Fig. 1; the effect of heating being, as the rolls cannot move endwise on the shaft, to make them bulge in the center of length. In the Loebtan shops they are held as shown in Fig. 2, so that most of the endwise expansion takes place from the center out towards the ends, thus minimizing the buckling while getting equal lateral stiffness.

ROBERT GRIMSHAW.

Dresden.

Some Considerations of the Economical Use of Exhaust Steam.*

BY WILLARD T. HATCH.

The principal item in the cost of steam-power is, as we all know, the fuel, and the exhaust steam from our best engines has in it 80 per cent. and more of all the heat put into the original steam by the fuel before its use in the engine. While this exhaust steam, as we call it, is about spent, so far as producing power under the original conditions of its use is concerned, it has still very great value under some other conditions of use, and the fact that it contains so large a proportion of the total expenditure of heat is well worthy of our most careful study.

Let us consider two only of these possible uses—namely, the heating of buildings and the production of additional power by its use in a condensing engine. Either or both of these uses are practical in most instances for a considerable portion of the time. It is evident that these two opportunities will vary with every case, depending upon the relative size of the building and the amount of power developed, as well as upon the outside temperature; and the point of our study is to determine the limits which make either one or the other of these two uses for the exhaust steam the more profitable under any given set of conditions.

Let us now, to become definite, assume the case of a building of given proportions in which a certain amount of power is developed, and consider the value of the exhaust steam for each of the uses we have mentioned, and we can then compare the results.

Take, for example, the building of a certain company, at Providence, R. I., which is equivalent to a structure 750 feet long, 51 feet wide and 52 feet high, exclusive of floors (say, four stories averaging 13 feet), with brick walls 20 to 24 inches thick and windows every 8 feet in each story on all four sides, the windows having forty lights, each 9 by 14 inches, and one-third of them protected with storm sash; flat roof of masonry supported on iron beams and averaging about 10 inches thick. About half of the building is heated by direct radiation from overhead steampipes, and the other half is heated by the warm blast. There are also a number of good-sized fans at work removing dust and supplying blast. The power is furnished by a pair of 18 by 48-inch Corliss engines, running non-condensing, developing something more than 250 horse-power, and the building is heated to 70 degrees Fahr. by direct steam before 7 A. M. We will first consider the use of the exhaust steam for heating. To begin with, how much steam have we, and how much do we need, or can we use?

Assuming that we develop, on an average, 254 horse-power at 28 pounds of steam per horse-power per hour, we shall evidently have 7,112 pounds of exhaust steam per hour, or 118.5 pounds per minute, at our disposal, less the cylinder condensation. During the first two weeks of December, 1896, with the thermometer at 15 to 20 degrees, several observations were made to determine the amount of exhaust steam condensed in the building. At that temperature there was almost no escape from the main exhaust pipe, which is closed by a back-pressure valve set for about 1½ pounds pressure, and only a very moderate escape from the vents at the ends of the various coils, just enough to show that they were actually filled with steam, with no live steam on any portion of the building. All the heating pipes in the building are drawn by gravity to one receiver in the basement, from which the water of condensation is pumped back into the boilers by a steam pump, which is started and stopped automatically by a ball cock and tank. By closing the connection between the steam pump and the boilers and allowing the receiver to overflow to a tank set on a weighing scale, it is a very simple matter to ascertain the total amount condensed and returned at any time. The observation showed the condensation in pounds per minute at the various temperatures taken, the average temperature inside the building being about 70 degrees.

Two observations taken at 16 degrees show a condensation of 110 and 111 pounds per minute. At 20 degrees the condensation varied from 71 to 109 pounds, averaging 91 pounds per minute, and at 40 degrees the extremes are 39 and 64 pounds, averaging 52 pounds. In a case like the one we are considering, there are numerous disturbing elements which affect the result more or less. Of these we naturally first think of the atmospheric conditions. Thus, for the same outside temperature the condensation will be greater in windy weather than in calm, and in cloudy weather than in clear. In the observations these conditions were not noted; their influence would evidently operate on both sides of the mean, and appears to be the main reason for the individual variations in the observations for any given temperature. Cylinder condensation would also account for some water, but this would be a nearly constant quantity, considering the uniformity of the load; but no careful observations were made to determine the amount.

A third disturbing element, but one which always tends to show an excessive rate of condensation for mild weather, is the condensation due to heating the feed water. Thus, with the outside temperature at 15 to 20 degrees, our exhaust is practically all condensed and returned to the boilers, and the fresh feed water supplied is very little—just enough to make up the losses at the vents—perhaps 2 or 3 pounds per minute, with an outside temperature of 40 degrees and condensation

* A Paper read before the Providence Association of Mechanical Engineers.

of about 53 pounds per minute to be made up. This 65 pounds will be made up of some fresh feed water and the condensation of enough exhaust steam to heat it. Thus, 1 pound of exhaust steam will liberate 966 heat units in condensing; this will be sufficient to raise 6.4 pounds water from 59 to 210 degrees—that is to say, we shall have 7.4 pounds of feed water at 210 degrees for every pound of steam condensed in heating it. The heating of 65 pounds, then, will mean the condensation of $65 \div 7.4 = 8.79$ pounds exhaust steam. So that if our observed condensation is 53 pounds per minute, we may conclude that 44.21 pounds is going to heat the building and 8.79 pounds to heat the feed water. Similarly, when the outside temperature is 70 degrees or over, and there is no condensation required for heating the building, we shall still condense enough to heat our feed water, say, 118.5 $\div 7.4 = 16$ pounds per minute, or, including the condensation of cylinders and exhaust connections, 18 to 20 pounds per minute.

The heating of the feed water is manifestly one of the first duties for the exhaust steam, as it is a constantly existing need. In this case it represents a saving of about 13½ per cent. both in the consumption of coal and of feed water. It is an economy almost universally practiced.

We will now consider another factor which we have to reckon with; it is very large, but practically indeterminate, at least in the time I have been able to use it. I refer to what may be called the incidental heat which is developed in the building. This incidental heat includes, first, the animal heat of the 800 or 900 workmen employed in the building; second, the heat developed by the friction and useful work of the machines; and third, during the time from four to six especially, by the heat from 1,500 to 2,000 gas jets.

This incidental heat factor tends to produce a steady, substantial rise in temperature inside the biulding, being zero at 7 A. M. and reaching its maximum at 6 P. M. I have assumed this maximum at 15 degrees, and support the assumption by the following considerations: First, it is a general experience that, barring sudden changes, with the outside temperature at 55 to 60 degrees at 7 A. M., no steam heat will be required inside the building to maintain a temperature of 70 degrees. With the outside temperature at 35 to 40 degrees at 7 A. M., and an inside temperature of 70 degrees, the steam in the intermediate stories of the building is shut off for the day at 9 A. M., and only used in some exposed quarters to a moderate extent until lighting-up time, when it is difficult to keep the inside temperature below 75 degrees without opening outside windows.

The loss of heat from a building varies directly with the difference between the inside and outside temperatures—that is to say, supposing the conditions as to winds and clouds to be the same, that there is no feed water to heat, and no incidental heat from within to raise the inside temperature, then with the inside temperature at 70 degrees the building loses twice as many heat units at 40 degrees outside temperature (which is 30 degrees below 70 degrees) as it will at 55 degrees (which is 15 degrees below 70 degrees).

The loss of heat from a building is principally due to conduction and radiation, contact of cold air or wind, and the air leakage, this latter varying largely with the perfection of ventilation provided for. These losses are variously estimated by different authorities, and no doubt vary considerably in individual cases, depending upon the thoroughness of construction, the quality of materials employed, and the exposure. In the case before us, I have made use of coefficients published in a treatise by the B. F. Sturtevant Company and credited by them primarily to the German Government, and secondarily to Alfred R. Wolff, M. E., in "The Heating of Large Buildings." These coefficients give the loss in heat units per square foot per hour per degree difference between inside and outside temperature for various materials and thicknesses. For our case they are as follows:

Brick walls 20″ to 24″ thick.....	0.22
Single glass windows.....	1.215
Double glass windows.....	0.572
Roof, taken as masonry 10″ thick..	0.35

Our building has approximately 65,000 square feet of brick walls, exclusive of windows; about 14,000 square feet of single windows; about 7,000 square feet of double windows, and about 42,000 square feet of roof. The coefficients, multiplied by their respective surfaces, give us

	Heat Units.
65,000 x 0.22 = ...	14,300
14,000 x 1.215 = ...	17,000
7,000 x 0.572 = ...	4,004
42,500 x 0.35 = ...	14,875
Making a total of.....	50,189

per hour per degree difference between inside and outside temperature. To this sum is to be added 15 per cent. to compensate for the effect of winds and the continual opening of doors, and to this an additional 80 per cent. for the effect of ventilating, which, taking the various fans in the building into account, produces the equivalent of a complete air change for the entire building every 20 minutes, making the total loss of heat 103,888 heat units per degree per hour $\div 966$, the number of heat units liberated per pound of exhaust steam condensed, equalling 107.5 pounds per degree per hour, or 1.79 pounds per degree per minute, and the value applied to [illegible] difference betweeen the inside and outside temperatures gives us the theoretical result. From the foregoing it appears that the observed and theoretical rates of condensation agree fairly well; in fact, a closer agreement would almost raise the suspicion of one or the other being too good to be true.

Having now considered the rates of condensation of our building for different temperatures, both from observation and theory, it remains to make the application to actual conditions of weather, and see what our needs for heating amount to in an average winter season. Our recollections as to the weather are misleading. Every cold snap or dry spell seems to us the coldest or dryest within the reach of our memory, while the elderly gentleman compares them scornfully to the conditions existing when he was a boy. We will therefore appeal to the record of the Meteorological Department of the Providence City Engineer's office, from October to May inclusive, for the years 1893, 1894, 1895. Taking the daily averages for each month at 7 A. M., 1 P. M. and 9 P. M., and the average of the daily maxima and minima for the month, the average of the observations for October at 7 A. M. is about 48, at 1 P. M. 58½, and for 9 P. M. 52½ degrees. The average of the highest daily readings is 59½ degrees, and of the lowest daily readings a little less than 45 degrees.

Reference has already been made to the incidental heat in the building, and to the fact that it causes a gradual rise of temperature inside the building, with a corresponding reduction in the rate of condensation necessary to heat the building. The effect of this heat is obviously the same as would result from the same use in the outside temperature, the amount of the addition being, as already assumed, zero at 7 A. M. and 15 degrees at 5 P. M. —say 1½ degrees per hour to the actual average temperature.

The average daily rate of condensation of steam required for heating our building during each of the cold months, compared with the total available supply, is as follows: For October, 21 pounds per minute at 7 A. M. and 0 at 9:30, amounting to 8 per cent. of the total amount available during the time it is used. For November, 44 pounds per minute at 7 A. M., and 0 at 1:30, amounting to 20 per cent. of the available supply. For December, 64 pounds per minute at 7 A. M., falling to 0 at 6 P .M., averaging for the entire day about 32 pounds per minute, or about 27 per cent. of the total supply. For January, 78 pounds per minute at 7 A. M., falling to 18 pounds per minute at 6 P. M., averaging for the entire day about 46 pounds per minute—say 40 per cent. of the total supply. For February the rate is very nearly the same as for January, running about 2 pounds higher. For March we have 54 pounds per minute at 7 A. M., and none used after 2 P. M., amounting to an average of about 26 pounds per minute, or 22 per cent. of the total supply during the heating portion of the day. For April we have 33 pounds at 7 A. M.,

and none after 12 o'clock, averaging about 16 pounds, or 13½ per cent. of the whole, during the forenoon. For May the amount used for heat was so small as to be negligible. From this comparison it appears that only during the months of January and February do we use approximately half our exhaust steam for heating. And if during these months we find the average temperature at 7 A. M. to be 23 to 24 degrees, it is plain that for the few mornings at 0 degrees we shall need about 50 per cent. more steam to maintain our building at 70 degrees, say 120 to 125 pounds per minute. Of course, in designing a heating apparatus (or almost anything else) we must figure on extreme conditions, so that averages are of very limited value in that direction; but in considering its use after it is installed, averages are very instructive.

While we have not considered the volume of the building in figuring the loss of heat, it still offers a comparison of possible interest. As stated earlier in the paper, our building is about equivalent to one 750 feet long, 51 feet wide and 52 feet high, exclusive of floors, but inclusive of walls, and the enclosed volume is about 1,800,000 cubic feet. On the basis of a condensation of 125 pounds per minute at 0 degrees, we have, by dividing, 1 pound per minute for every 14,400 cubic feet, or, allowing 28 pounds of water per horse-power per hour, 1 horse-power for every 6,710 cubic feet.

We now come to the other side of our question—that is, What is the value of our exhaust steam if used to run our engines condensing? As already assumed, when running non-condensing our engines will require 28 pounds of steam per horse-power per hour; when running condensing they will require, say, 22 pounds steam per horse-power per hour. That is to say, the exhaust steam is worth 6 pounds of live steam per horse-power per hour—say 6-28, or 21.4 per cent. of the value of live steam. On the basis, then, of 254 horse-power, the value of the exhaust steam for the condensing engine will be $254 \times 6 = 1{,}524$ pounds per hour, or 25.4 pounds per minute, and it will clearly be profitable to use it for this purpose—that is, to run the engine condensing only when the condensation of the exhaust steam for heating the building is less than this amount. Since exhaust steam is worth, pound for pound, almost as much as live steam for heating purposes, it follows that only when the use of steam for furnishing power amounts to about five times as much as the steam used for heating will it be profitable to run condensing and heat with live steam. In our case, however, having a pair of engines, and only using about half of our exhaust steam, it is evident that one cylinder might be run condensing continuously, and the other non-condensing, using its exhaust for heating until the needs of the building fall below 12.7 per minute. We find this to be the case whenever the outside temperature is above 52 degrees, or

During—

October	After 8:30 A. M.
November	After 12:00 M.
December	After 2:30 P. M.
January	None at all.
February	None at all.
March	After 1:00 P. M.
April	After 10:30 A. M.
May	All day.

and during the remainder of the year continuously.

That the condenser will be a profitable investment we may accept without discussion, and it is of interest to note that as the load increases, the temperature at which it can profitably be used falls, and the length of its profitable season increases. We may also remark that at the time of changing from non-condensing to condensing the gain will be zero; but as the temperature rises the gain will increase, reaching its maximum when no steam is required for heating. While numerous other interesting deductions may be drawn, we may consider the questions with which we started sufficiently answered, so far as relates to this particular case.

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A Practical Indorsement of Compressed Air.

As our readers have been informed, an extensive and costly engineering work is now in progress in New York City in the construction of the Jerome Park reservoir, a part of the Croton system. The work is expected to cost $7,000,000, and it will still be several years before it is completed. As the rock drills, hoisting engines, pumps and other machinery are distributed over a large area, compressed air has been employed, and very satisfactorily, as the means of power transmission, a large Ingersoll-Sergeant Corliss cross-compound condensing air compressor being installed in one of the principal buildings of the old Jerome Park race course. As usually happens in such cases, additional machinery has been put in operation from time to time until now the supply of compressed air is insufficient. A large air compressor is a rather costly machine, and as there happened to be a bountiful supply of steam at the power house it was thought that steam might be employed for a portion of the work, and the cost of an additional compressor might be avoided. Accordingly, about 2,000 feet of 4-inch pipe were laid and the steam was turned on. At the further end of the pipe little more than a good stream of water was delivered, and as the machinery employed is not designed to be operated by water power, a second compressor of greater capacity than that now in operation was hastily ordered by telephone a few days ago, and the company named above are now rushing its construction.

Cost of Trolley Power.

A table taken from the annual reports of the Railroad Commissioners of New York and Massachusetts for nearly all of the street railway properties shows the cost of the electric power required to run a car one mile under average conditions of load, etc. The table gives the number of cars owned, the car mileage per year and the cost of the electric power per mile and per passenger. Of the nineteen companies operating less than 250,000 car miles, four are obtaining power at a cost of less than 2 cents per car mile, six between 2 and 3 cents, five between 3 and 4 cents, one between 4 and 5 cents, and three at more than 5 cents; of the five companies operating over 5,000,000 car miles per year, one obtains the power at less than 1 cent per car mile, three between 1 and 2 cents, and one between 2 and 3 cents; other similar figures are also given between these limits. The Brooklyn Heights Company has the cheapest power, 0.86 per car mile, followed by the Binghamton with 0.94. The cost of power for Massachusetts roads includes repairs and depreciation of the station plant, which is not the case of the New York roads.—"Street Railway Journal."

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A new and interesting use for graphite has been discovered in connection with brazing, and it is now largely used in some of the bicycle factories. It is found that by mixing a certain quality of graphite (which is supplied by the Jos. Dixon Crucible Company) with water or turpentine to the consistency of a thin paste and applying it to those parts of a steel tube which it is desired that the melted brass shall not adhere to, the graphite effectually prevents this adhesion, and thereby does away with much filing and other work formerly necessary to remove the brazing material. This seems to result from the fact that the graphite has a strong affinity for metal surfaces, and at the same time is not affected by the heat; thus it simply keeps its place upon the tubes during the heating and prevents adhesion of the brass.

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The heat of the sun seems to be one of the things not as yet very closely determined. The estimates of the most eminent astronomers and mathematicians have such a range as this: Pouillet, 1,400° to 1,800° Cent.; Deville, 2,800°; Prof. Langley and Lord Kelvin, 8,000°; Sir Robert Ball, 18,000°; Sporer, 87,000°; Secchi, 10,000,000°.

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Recently we published an item in which we mentioned a newly invented lathing machine and gave some figures as to its capacity. We have received an inquiry for further particulars about this machine and would like to know the name and address of the inventor or manufacturer of it.

AMERICAN MACHINIST

Published Thursdays by

American Machinist Publishing Co.,
256 Broadway, New York.

John A. Hill, President and Treasurer.
C. A. Hansmann, Sec'y.

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"Female Labor in Machine Shops."

Our esteemed contemporary, "The Iron Age," is moved to righteous indignation by what it conceives to be a novel employment for women. It takes as its text a statement made by a paper published in Toledo, O., to the effect that girls are now employed in the factory of the Lozier Manufacturing Company, of that city, on milling machines, drill presses and other machines used in the manufacture of bicycle parts. Our contemporary remarks upon this as follows:

"It is an experiment not to be commended, and it is to be hoped that the first trial will be so unsatisfactory in results that it will speedily be abandoned. One of the proud boasts of Americans has been that in this country a woman commands greater respect than in any other country on earth. Women here are not unsexed as in many other portions of the world, where they perform the most exacting manual labor by the side of men. Occupations in which women can with perfect propriety be employed, and for which they are better suited than men, are steadily increasing, but the doors of machine shops should not be opened for them. Any advantage gained by thus employing female labor would only be temporary, as other factories would be forced to do the same thing in order to reduce costs to the same extent. The degradation of American women would proceed rapidly, while those who began it would derive no particular benefit."

With the sentiment of this we entirely agree; but, the fact is that a bicycle factory is not a machine shop; it is simply a factory, and in factories doing similar work women and girls have been employed in this country for generations; in fact, such employment of them is and has for a long time been common in the New England States. We find by inquiry that these girls are doing only such light work as is commonly done by women and girls in Eastern factories, but is not so common in the Western section of the country. We entirely agree that it would be better if women and girls were not employed on such work; and wish that the conditions were such that there would be no incentive to such employment of them, but to assume that the company named is leading the way in this matter or that it is doing anything new is a mistake. A further fact is that whether American women are degraded by such employment or not depends very much upon the conditions of their employment, and their surroundings. In our issues of March 25th, April 1st and 15th, we illustrated and described a factory in which many women are employed. To say that these women are in any way degraded or that their condition is in any way inferior to that of other women who are obliged to earn their living in the same town, either by domestic service, by clerking, or even by teaching, is to say what any resident of Dayton would probably be ready to deny. We do not know just how the women and girls employed by Lozier & Co. are treated, but that it is possible to treat them in such a way as to involve no degradation of or hardship for them more than accompanies other kinds of employment, has been abundantly proven.

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Definite Limits of Variation in Machine Tools.

Elsewhere in this issue we publish an article by A. A. Fuller, strongly advocating definite limits of variation in machine tools. Mr. Fuller's article is the outgrowth of experience in doing heavy work to a close and rigid specification of variation limits stated in definite terms, and, in our opinion, is well worth careful consideration.

We have ourselves long been convinced that the present practice in regard to this matter is wrong, and something over five years ago* we expressed the opinion that, since the terms "accurate work," "first-class workmanship," etc., mean entirely different things in different shops, and, in fact, have no definite meaning whatever; definite terms should be substituted for them, and that a buyer of tools should be able to know just what degree of accuracy he is paying for, and should know whether the commodity paid for has been delivered or not. It is useless to ignore the fact that a very large proportion of the work done in machine shops can be done just as well by machine tools of a very moderate, or even indifferent, degree of accuracy, as by the finest tools possible to construct; while for other kinds of work, the utmost possible refinement is well worth its extra cost. Why would it not be in the interest of all concerned, to so arrange things that the man who requires accurate tools, and expects to pay for them, should be enabled to know definitely just what degree of accuracy he is getting?

As we remarked in the article previously referred to, "When buying iron or steel, the amount we pay for is definitely stated in pounds; there is no good reason, when we are paying for accuracy in machine construction, that the degree of accuracy should not be stated in equally definite terms."

We think such a practice would be especially advantageous for the builders of the best tools. They know that a very large proportion of the cost of construction is entailed by securing a near approach to absolute accuracy; and they also know that the claim of "accuracy," "first-class workmanship," etc., means just as much to many buyers of tools, especially foreign buyers, when made by the representative of the most inferior builder in America, as when made by the best one, and that, in many cases, that which we call "big talk," but which has absolutely no definite meaning, "goes."

We may easily imagine the plight of such a salesman who, after expatiating upon the absolute perfection of the lathe he is offering at half the price of another by a first-class builder, is confronted by that builder's bill of particulars, in which limits of variation within which he guarantees his lathe to test, are stated in figures and definite terms which mean the same thing to everybody and will cost each builder about the same to secure, and there can be no reasonable doubt that if this were the general practice, many good tools would go in where poor ones now go.

Indeed, we can see no insurmountable obstacle to going further and taking a leaf from the experience of the watch manufacturers, who offer a watch movement practically just as it comes from the tools and the assembler's bench at a cer-

* Issue of June 30, 1892, under title of "What Is Accuracy?"

tain low price, while they offer precisely the same movement, adjusted to temperature and position, at a considerably higher price; the latter being marked "adjusted," to distinguish it.

Why should it not be possible for the builder of mowers, for instance, to buy, of the same builder if he chooses, lathes, drill-presses and milling machines for use in his tool-room or machine shop, that have been adjusted and are accurate; while for his factory he puts in the same machines, except that they are delivered to him practically as they come from the tools of the builder, and with no guarantee of variation limits?

Good design usually accompanies refined workmanship; why is it not practicable to so arrange that a man who appreciates good design in machine tools, and is willing to pay for it, can at the same time pay for refined accuracy or not, according to the requirements of his particular business? Is there any good reason why the man who builds windmills or horse-powers should be asked to buy a lathe or other machine tool in all respects just like the one sold to a builder of watch tools? and would it not be in the interest of the best builders, and of the craft in general, if either of these men could select the design of machine which suited him best, and then pay for and obtain the degree of accuracy required for his work? In any event we feel confident that the practice of specifying limits of variation is a step in the right direction, and we hope to see it generally followed.

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Technical Books.

THE CALCULUS FOR ENGINEERS. By John Perry, Professor of Mechanics and Mathematics in the Royal College of Science, London. Edward Arnold, New York. 378 4¾ x 7-inch pages. Price $2.50.

This book recognizes at the outset the comparative failure of the usual instruction in Calculus, so far as its mastery to the point of usefulness is concerned, and is an avowed attempt to present the subject in a way which will make it a useful tool in the hands of the practicing engineer, instead of being largely a piece of mental training of his school days, to be forgotten thereafter with the marvelous rapidity of which it is capable. To this end it endeavors to present the fundamental ideas of differentiation and integration in a manner which will cause them to become incorporated in the student's mental make-up. Illustrations from everyday life are made use of to show that these fundamental ideas are really part of the conceptions of every one, except that they have not had the mathematical names applied to them by those who have not made a formal study of the subject.

The author is an experienced teacher of mathematics, and this book gives the major portion of his course in Calculus to engineering students. His preface gives an account of the progress made by his students which is certainly highly satisfactory.

A unique feature of the book is the entire abandonment of the formal literary style with which such subjects are usually presented. The style is familiar and personal to a degree that will put the student in touch with the author at once. An occasional bit of humor in a treatise on Calculus, is certainly a rarity.

There is no doubt that the movement which this book represents is an excellent one, and that it is bound to grow. Mathematics as a useful tool deserves a high place in every engineering college course, but as a means of mental discipline it deserves no place whatever.

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Personal.

Chief Engineer A. V. Zane, U. S. N., has been ordered to temporary duty at Washington Navy Yard.

Passed Assistant Engineer W. W. White, U. S. N., has been ordered to the Bureau of Steam Engineering.

Passed Assistant Engineer O. W. Koester, U. S. N., is detached from the Ericsson and ordered to the Rodgers.

Commodore Philip Hichborn has been reappointed Chief of Bureau of Construction and Repair of the Navy Department.

We will consider it as a favor if our readers will send in items of news regarding changes of foremen, superintendents or others prominently connected with the machine business. Such items are legitimate news of the trade, and we are glad to make room for them.

Mr. C. P. Benns, who for the past five years has been the teacher of applied mechanics and machine work in the Providence (R. I.) Manual Training High School, has accepted an appointment in the Teachers' College of New York City, and will begin work there about October 1st.

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Shop Heating.

We publish elsewhere in this issue an article by Williard T. Hatch, which is a most thorough and rational investigation of the subject of shop heating by exhaust steam. Several points are brought out in this paper, which, so far as we know, are new, and the paper should be carefully read by all who wish to be well informed on the important subject of rendering machine shops comfortable and healthful at the least possible expense.

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Death of Thomas R. Morgan.

Thomas R. Morgan, Sr., died suddenly at his home, Alliance, Ohio, on September 6th. Mr. Morgan was born in Penydarran, Glamorganshire, Wales, in 1834. He came to the United States in 1865 and worked as a machinist and master mechanic in the Cambria Iron Works, Johnstown, Pa., the shops of the Allegheny Valley Railroad, and the Atlas Works, engaging in business for himself in Pittsburg in 1868, manufacturing steam hammers and special machinery. The works of the Morgan Engineering Company were started by him in 1871.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(133) L. S. K., Monmouth, Ill., asks: What is the best way of removing salt which sticks to steel parts that have been hardened? It there anything better than fresh water? A.—We know of nothing better than fresh water, and if this is used plentifully, it will, of course, dissolve and wash away the salt. If, then, the articles are immersed in lime water, rusting will be prevented.

(134) H. W., Camden, N. J., refers to our use of the term "current of 2,500 volts," in a note referring to the cutting down of live wires, in our issue of August 26th, and asks if it is permissible to use the term volts as a measure of current. A.—As you understand it, no. The voltage measures the pressure only of the current. The term was used in the note referred to, because the voltage indicates the degree of danger in handling a live wire, which in this case was such that most men would prefer to let it alone—same as a buz-saw in motion.

(135) O. S., Cincinnati, writes: In the new book, "Gas, Gasoline and Oilvapor Engines," by Gardner D. Hiscox, M. E., on page 10 it reads: "To any given volume of a gas, its expansion may be computed by multiplying the coefficient 1-273 by the number of degrees of acquired heat." This would mean:

$$\frac{v}{v_1} = \frac{1}{1 + 2\frac{1}{7}\frac{3}{3}\,t}$$

when t equals number of degrees of acquired heat. Now it seems to my mind it ought to be

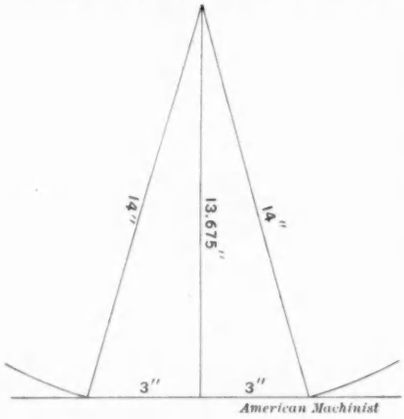
$$\frac{v}{v_1} = \frac{1}{(1 + 2\frac{1}{7}\frac{3}{3})\,t}$$

in the way of computing compound interest. Will you oblige me by having somebody tell me what is the matter? A.—Dalton's law of the expansion of gases by heat asserts that a gas at any temperature increases in volume for a rise of 1 degree by a constant fraction of its volume at that temperature; but according to Gay Lussac, the increase of volume is a fixed proportion of its volume at the freezing point, and refined experiments by Regnault and others show that Gay Lussac's law is much more nearly true than Dalton's. If the initial volume is at the freezing point, your first equation expresses Gay Lussac's law, and is correct, and for other initial temperatures approximately so. Dalton's law would seem to be the more rational; but Mother Nature thinks otherwise, wherein she follows one of her erratic habits.

(136) "Pumping Engineer," Sanger, Tex., writes: I elevate 730 pounds of water 40 feet for every pound of coal consumed in the boiler furnace. Is this economical pumping? A.—Whether this is economical pumping or not depends upon how much is pumped, and with what kind of pumping engines it is done. The work amounts to 2,920,000 foot-pounds per 100 pounds of coal. The highest record for pumping that we know of was made by

the triple-expansion pumping engines at Milwaukee, which gave a duty of 143,306,000 foot-pounds per 100 pounds of coal, and the Corliss Pawtucket pumping engine, one of the most famous in America, gave a duty, on test, of 138,126,000 foot-pounds per million British thermal units; 1,000,000 British thermal units being roughly what may be expected from 100 pounds of coal. Compared with such performances, your pumping is, of course, very far from economical, and yet it may be as economical as it can be with your particular pumping plant and with the amount of pumping you have to do, particulars regarding which you do not give.

(137) S. T. G., Philadelphia, asks: Is it true that a cyclometer will register a greater distance traversed by a pneumatic tired bicycle ridden by a heavy man than when ridden by one of light weight, the actual distance, the condition of the tires and other particulars being the same in each case? A.—It is true, although the difference would be small. The compression of the tire under the weight of the rider reduces the working radius of the wheel, and for a heavy rider of course more so than for a light one, so that for a long distance the wheel ridden by the heavy man would make more revolutions than for the other. A simple experiment will demonstrate the principle. Take an



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unloaded bicycle on a smooth floor, and back it against a wall for a start. Mark the tire, with a pencil or otherwise, so that a complete revolution of the wheel can be noted. Move the bicycle in a straight line until a complete revolution of the wheel is made and place a box or other suitable stop before the wheel at that precise point. Now let a man get on the wheel and start in a straight line as before, and it will be found that when the revolution of the wheel is completed, the wheel will not reach the box where the wheel stopped before by perhaps a couple of inches. The difference in travel for men of different weights may be only a quarter of an inch, or more or less, according to the difference of weights. In a case we actually tried, with a rider of average weight on the wheel, the length of tire bearing was about 6 inches on the floor, and the travel for the revolution was about 2 inches less than for the wheel without load. This would agree very nearly with the figures if we computed on the same data. Thus the wheel being 28 inches diameter and the full radius 14 inches, the vertical radius under the load would be: $14^2 - 3^2 = 187$ and $\sqrt{187} = 13.675$. The diameters for the two radii would then be 28 inches, and $13.675 \times 2 = 27.35$ inches, and the circumferences: $28 \times 3.1416 = 87.97$ inches, and $27.35 \times 3.1416 = 85.92$. Then $87.97 - 85.92 = 2.05$.

(138) H. B., Brussels, Belgium, writes: Will you tell me at what speed iron and steel can be tapped and threaded? A.—Very much depends upon the conditions in each case. For ordinary standard threads a speed of about 16 feet per minute is correct where the stock has not been previously heated by heavy turning cuts removed from it. If it has been thus heated, however, the speed should be somewhat slower. The speed at which such work can be done in the screw machine is usually determined by other considerations than the possible maximum speed at which the threading tools can work, because the turning operations which consume most of the time are those which it is most desirable to have done at the proper speed, the threading operations then being done at any available speed within the maximum which can be secured without too much trouble in changing belts, etc., and in arranging for this it is much better to do the threading at a speed as slow as 5 feet per minute than to let it go as high as 20 feet, especially where the stock has been heated as mentioned above. A die generally cuts much smoother when running at a slow speed. Rough bolt work can be done at a speed as high as 20 feet per minute, with thorough lubrication; but for accurate threads it is best to keep below 16 feet per minute.

(139) W. L., Wayland, N. Y., asks: What pressure on a railroad brake shoe is required to slip the wheels, the weight of the car being 60,000 pounds, the diameter of the wheels 32 inches, and the size of the brake shoe 3 x 12 inches. A.—No single answer can be given, as the coefficient of friction varies between wide limits depending on the speed. The extensive experiments of Galton and Westinghouse give the following mean values of the coefficient for different speeds:

Velocity.		Mean Coefficient of Friction.
Miles per Hour.	Ft. per Second.	
60	88	.074
50	73	.116
40	59	.140
30	44	.164
20	29	.192
10	14½	242
Just moving	....	.33

This table gives the coefficient of friction for the brake shoes under which the wheels slide. The value of the coefficient of adhesion of the wheels to the rails, where there is no sliding, is from .30 to .33 on dry rails. If at any speed the pressure on the shoe is such as to bring the total friction of the shoe above the adhesion of the wheel to the rail, the wheel will slip. The diameter of the wheel and the size of the shoe between ordinary limits have no influence on the pressure required.

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Some time ago we commented upon the organization known as the Stove Founders' Defense Association, and gave some favorable results which had come from its organization—results which, it will be remembered, have been favorable not only to those manufacturers who compose the association, but for the molders employed by them as well. It is now proposed to form a similar association among the founders not interested in stove manufacture, and a preliminary meeting was held for that purpose at the Manufacturers' Club, Philadelphia, on the 24th ult. It is expected that the organization will be completed and that good results will come from it. John Penton, of "The Foundry," has taken a prominent part in the preliminary steps looking towards the new organization. It seems to us, however, that in any attempt to thus organize founders engaged in widely varying lines of work, done under widely varying conditions, there will be some special difficulties which were not encountered by the associated stove founders.

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Railroads are good business barometers, because they are among the principal factors of business activity. It cannot do without them, and the more brisk the current of business, the more traffic it gives to the railroads and the greater is their amount of work. Judged by this standard, the South seems to have led in the present march of prosperity, for its railroads began to feel the pressure of business early in the year. Statistics just published show that, in the six months from January 1st to June 30th, the earnings of the forty leading railroads of the South increased $1,489,106, or 11.71 per cent. over their business for the same time last year. The enormous cotton crop now beginning to come forward will keep up this activity, and, in addition to the general traffic, is already taxing the resources of the roads. An era of pronounced, healthy and, let us hope, permanent prosperity has opened at last in the South.

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A pleasurable emotion will be experienced by every American at the announcement of the fact that the American Line steamship St. Louis now holds the record between New York and Southampton; the time of this vessel's recent passage being 6 days, 10 hours and 14 minutes, which is 41 minutes shorter time than the previous best time made by the Hamburg-American Line steamship Fürst Bismarck. It is worthy of note that both the St. Louis and St. Paul, though they at first did not make particularly fast time, have steadily improved in service and have gradually lowered the record by successive steps since the first. The St. Paul holds the westward record, her fastest time being made in August of last year, in 6 days, 31 minutes.

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Some time ago one of our foreign letters referred to the inferior quality of drop forgings made in Eng'and, and complaints of British bicycle manufacturers on account of them. A fact which may be of some interest in this connection is that a drop forging plant is to be established in Birmingham, England, for the Components Cycle Co., which will include a

complete outfit of drop hammers, presses, dies, tools, fixtures, die sinking machinery, etc., which will be entirely equipped with American machinery and is intended to be a model plant throughout. Ten drop hammers will be installed at first with the expectation of increasing the number later. The Billings & Spencer Co., of Hartford, Conn., have contracted for the equipment.

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When it comes to the general use of gas the price of the gas has something to do with it. We all know that the gas engine is more commonly used in England than in the United States, but the explanation is simple. Boston, Mass., and Manchester, England, have nearly the same population. The consumption of gas in Manchester in one year was 3,636,000,000 cubic feet, or more than was used in the entire State of Massachusetts, but the price of gas in Manchester was 60 cents per 1,000 feet, while in Boston at the same period the average per 1,000 was $1.50. The price of gas is much too high.

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Forty-five pages of the Patent Office Gazette of Aug. 31 are occupied by the claims of thirty additional patents to Francis H. Richards, of Hartford, Conn., for automatic weighing machines. The total number of Mr. Richards' patents, issued and pending, in this one line, is now 240, with more to follow. It is said at the Patent Office that a certain Examiner in Chief is getting into the habit of ejaculating, "Give us this day our daily weighing machine."

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It is reported that the Westinghouse Electric & Manufacturing Company has received from its European branch notice of the award by the Metropolitan Electrical Supply Company of the contract for a large electric lighting plant to be installed in London. It is said that the contract amounts to between $350,000 and $400,000. All of the electrical apparatus will be made at the works of the company in East Pittsburg, Pa.

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The United States Navy Department is to build a sailing ship, the first authorized since the war. It is for a practice vessel for the cadets of the Annapolis Naval Academy. It will qualify the young men to read Captain Marryat and Fennimore Cooper more understandingly. Nothing can be learned from it of the maneuvering of monitors or battleships.

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It is announced that in the four months since the new Canadian tariff went into force, the British exports to Canada under the new preferential rate declined 14 per cent. The greatest decreases are in iron and articles manufactured from iron, and in clothing. The decrease in the iron trade with England is due to Canadian purchases in the United States.

A Mechanical Glassblower.

No invention in recent years has been more surprising than that of the machine glassblower now being perfected for a manufacturing firm in Muncie. From the infancy of the glass industry, almost from time immemorial, glassblowers have been regarded in a peculiar sense as skilled workmen. Their work has been regarded as difficult and delicate, and they have commanded exceptionally high wages. Now all this is to be changed by a machine which, it is said, will do the work as well or better than the human blower, while one machine will do the work of three blowers at less than half the cost. Such an invention as that cannot fail to have an important effect on the glass industry. Its first effect will probably be to throw out of employment a considerable number of skilled workmen, but the industry will soon adjust itself to the change, and eventually all classes will be benefited by the invention.—Indianapolis Journal."

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Boys greased the tracks of a suburban trolley road at Philadelphia a few nights ago, and one of the cars, on which there were but three or four passengers, slipped back a steep incline, narrowly escaping collision with a train of the Reading Railroad.

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Commercial Review.

NEW YORK, Saturday Evening, Sept. 11.

THE ENGINE MARKET.

One naturally expects to hear that, by this time, the general business revival has reached the engine market in force. A pretty extended tour through the New York machinery district was made by the writer this week, with the idea that such expectations might be verified. The New York market should furnish a fair criterion of the rest of the country, since several companies have here their chief town offices, and minor agencies abound like the sands of the sea-shore.

To be candid, we shall have to wait a little longer before everybody in the engine market feels the business improvement, or even pretty nearly everybody. There are certain large concerns whose works are very busy. They have been doing so well for a while past that they hardly know whether they are doing more and more or running evenly. There are others, of minor grade, who report improved business. But there are a good many builders, besides, who may be considered excellent criteria of the market, and who certainly do not find that there is any material improvement in their business. These include many companies who make high-speed engines and cater to the electric-lighting trade. Now is the time of year when it might be supposed that such engines would be in especially good demand; but it seems that the office buildings, etc., which require them have lately been a little slow about placing contracts.

Among the last in this city to order steam plants, were the Army and Navy Building, which bought Oil City boilers, and the Windsor Hotel, which decided upon a Westinghouse engine. The Exchange Court Building has placed, or is about to place, an engine contract. The Arbuckle sugar refinery, of Brooklyn, has just contracted for 1,800 horse-power of engines, of a prominent Western make. The new Park Row building, the Singer building and the building going up at 95-97 Liberty street, in the heart of the machinery district, will soon be in the market for steam plants. The keenness of competition in all lines of the building industry, from excavation and shoring to engines and dynamos, is such that the chief contractor for one of the buildings above mentioned is said to be literally besieged by would-be sub-contractors. The New York Belting and Packing Company, whose factory is located at Passaic, N. J., are in the market for a 1,000 horse-power condensing engine of the Corliss type. Sterling boilers for the same are reported to have been ordered.

We give below in unclassified form a few odds and ends of market gossip, showing how one and another of the engine and boiler sellers view the situation.

One notices a better demand for agricultural engines to go to the Southern States, and for lighting engines. A Corliss engine agent notes a little better inquiry for the latter purpose. Another speaks of fair sales of their line of road machinery, owing in part to the fact that the coming incorporation with Greater New York has stimulated suburban towns to make improvements. This is not the time of year for that class of business, and that it holds its own is a good sign. Rather dull exports of engines with not so much demand from South Africa as might be expected, is one report; a trifle better inquiry from English possessions is another.

Remarks one: "I have spent considerable time in Pennsylvania lately. The iron men are feeling in good spirits. One boiler plate company was asked by an Eastern locomotive works to name a price on plates for 100 locomotive boilers. They asked a figure which they felt that they were justified in quoting, and it was refused. They still made no concession, feeling that they could hold their ground. Soon after, the locomotive company sent to them again and accepted their terms." Another party states that the engine business is dull in the West, in Pittsburg, for instance.

The Lidgerwood Manufacturing Company, which is one of the largest engine concerns having office headquarters in this vicinity, are enjoying gradually improving conditions. Their cableway department is especially active, and in mining

(Continued on page 37.)

Business Specials.

Gear wheels, gear cutting. Grant; see page 16.

Good pattern work. H. D. Phelps, Ansonia, Conn.

E. H. Randall, fine tools. See page 10, this issue.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Fine Smooth Pat. Cast. H. D. Phelps, Ansonia, Ct.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Gear and milling cutters, adjust. reamers, counterbars and tools, vert. millers, drill pr., cutter and surf. grind., shears. R. M. Clough, New Haven, Ct.

Cost of Manufacturing—Experienced manager will establish system of costs, giving exact account of every detail. Charge based on saving effected. Correspondence solicited. Geo. C. Thomas, 99 Nassau Street, New York, Room 212.

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Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday Morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

Pr'c. to'l. & draft. w'nts work. Box 218, AM. MACH.

Machine designer wants pos. Box 190, AM. MACH.

Toolmaker, exp. on jigs and fixtures and fine auto. mch., desires pos. Box 214, AMER. MACH.

Experienced draughtsman, tech. grad., desires position, N. Y. or Brooklyn. Box 216, AMER. MACH.

Mech. draftsman, first class recommendations, is open for engagement. Box 212, AMERICAN MACH.

Brass fdy. foreman wants pos.; mixes all metals; years of exp.; first-class ref. Box 206, AMER. MACH.

Wanted—Pos. as draftsman or pattern maker; practical man; best refs. Box 209, AMER. MACH.

Machinist, comp.t, desires pos., foreman or asst., hndls. men; best results. N.Y. or Bklyn. 193, AM. MACH.

Wanted—By a first-class mechanic and successful shop manager, situation as foreman or supt.; best of refs. Box 210, AMERICAN MACHINIST.

Experienced mch. draftsman wants pos.; would take charge of small drawing room and act as book or time keeper in connection. Box 213, AM. MACH.

Wanted—Situation by expd. man holding pos. of foreman; good tool maker; punch and dies, jigs, etc.; automatic machinery. Box 208, AMER. MACH.

Tech. grad., mem. A.S.M.E., having 6 years exp. with leading engine builders, wants pos. as city representative or trav. salesman. Box 217, AM. MACH.

First-class drafts. and des. for special mach'y is open for eng. Exp. in mach'y for chem. tech. purp. (rubber, gutta percha, etc). Box 191, AMER. MACH.

Situation wanted by first-class pattern maker, experienced in all kinds mchy.; six years abroad and eight years in U. S.; New York, Pennsylvania, New Jersey preferred. Box 197, AMER. MACHINIST.

Machinist, thoroughly prac. and comp. (39) speaking Eng. and German, wide exp. in building auto. and special mchs.; well up in tools and dies; held responbl. pos.; des engmt.; best ref. 215, AM. MACH.

Situation wanted by practical mech. eng. as supt. or manager of mach. shop building special mchy. or taking large contract work; large exp in estimating prices and handling men to advantage; best reference; strictly reliable in every respect. Address Box 196, AMERICAN MACHINIST.

A technical graduate with good record, ability, and push; 5 years experience designing and superintendence on compressed air and blowing mach., steam engines and general work, is idle because of difficulties between companies; would accept drafting with chance to advance Box 211, AM. MACH.

I want a permanent position in electrical or mechanical engineering where I can work out ideas and furnish new ones; design and construct new plants or improve existing methods, tools or machines. Have an extended experience in electrical station construction and the design of special electrical work; am also acquainted with bridge, dock and building construction, and have served the U. S. Government as Supervising Engineer for a number of years, also inspected and condemned boilers, steamboats, etc., selected steam machinery, and designed same for them; my specialty is the design and construction of special machines and processes for doing work economically and reducing the cost of manufacture; understand asbestos manufacturing. Address James F. Hobart, 230 Eleventh St., Brooklyn, N. Y.

Help Wanted.

Drop Forgings—A large plant is being put down in Birmingham, Eng., with vacancies in all depts. Apply first to Billings & Spencer, Hartford, Conn.

Wanted—A man who thoroughly understands making steel type for typewriter work; state experience and wages wanted. Box 204, AM. MACH.

Wanted—Foreman in a large, job machine shop in New Jersey; must be an all-around man. Address, with copy of references and wages required, Box 207, AMERICAN MACHINIST.

Wanted—Engineers for large compound Corliss and triple expansion engines; must understand indicator; send copies of ref. and state wages required. Address "New Jersey," AMERICAN MACHINIST office.

Wanted—A firm taking up the manufacture of typewriters wishes to engage the services of a competent foreman, one having had exp. in that line or small interchangeable work. Answer, stating age, exp., refs. and salary, "Typewriter," AMER. MACH.

Wanted—Boss firemen to superin't several boiler plants at large works in New Jersey using bituminous coal; must understand thoroughly the burning of coal economically; send copies of ref. and state wages required Ad. "Redfern," AM. MACH. office.

Wanted—A competent foreman to take charge of one of our machine departments; must be a good machinist, with a few years of varied exp.; between 30 and 40 years old, married and of good habits. A permanent pos. to the right man. Ad. M. P. Breckenridge, Supt., The H. B. Smith Co., Westfield, Mass.

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Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S.M. York, Clev'd, O.

Calipers & Gauges. F.A. Welles, Milwaukee, Wis.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

For Sale—Small machine shop, having good repair trade, in town of 1,400 inhabitants; no opposition. Box 171, AMERICAN MACHINIST.

Model Locomotives—Complete castings, latest N. Y. Cen. standard, up to date; 4c. in stamps for cat. alog. G. H. Olney, 163 Herkimer St., Brooklyn, N.Y

Lathes, planers, drills, milling machines, vises, also brass working machinery second-hand; must be modern and in first-class condition. C. C. Wormer Machinery Co., Detroit, Mich.

For Sale—6 lathes, 2 boring mills, 1 planer, 4 drill pr. sses, 3 emery wheel stands, shafting, pulleys, hangers, chain blocks, vises, drills, etc., all in good order. Address Box 853, Cincinnati, Ohio.

For Sale—Gasoline and gas engine plant, one of the oldest manufactories of gasoline engines in this country; over 700 engines in operation; will bear investigation; good reasons for selling. Address Box 205, care of AMERICAN MACHINIST.

Opportunity to secure part ownership in good paying electric mfg. plant; large, modern, brick buildings, with fine tools; perfect equipment; located in mfg. center; business established in 1881; applicant must have $10,000 and devote time to business. Address Box 195, AMER. MACHINIST.

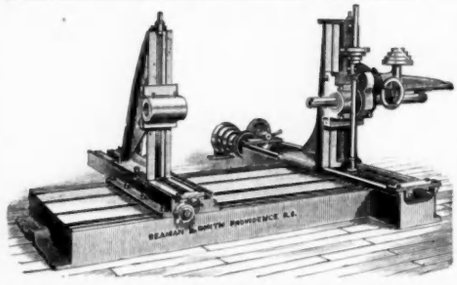
WANTED.

The services of a first-class mechanic to take charge of a medium sized Agricultural Implement plant. A man who is thoroughly acquainted with modern methods in getting out wood and iron work and not afraid of work. All correspondence confidential. Address, giving experience, age and reference, W. 19, care Lord & Thomas, Chicago, Ill.

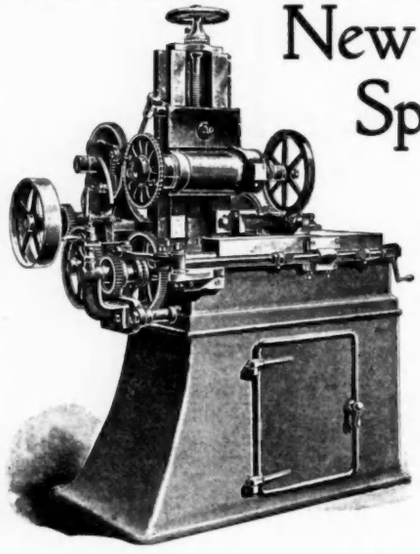
VAN NORMAN "DUPLEX"

Milling machine allows cutter spindle to be set horizontal, vertical OR ANY ANGLE BETWEEN instantly. It saves fixtures and cutters on general work.
Ideal tool room machine.

WALTHAM WATCH TOOL CO.
SPRINGFIELD, MASS.
OR
WALTER H. FOSTER,
Manager New York House, 129 Liberty St.



I am very useful and handy but do not recollect making your acquaintance. Should you desire to know me, please ask BEAMAN & SMITH, Providence, R.I., to send you descriptive pamphlet No. 1, that will introduce and tell all about me.



New Automatic Spur Gear Cutter.

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Cuts Gears up to 24 in. diameter, 10 in. face.

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∴ Full particulars and prices on application.

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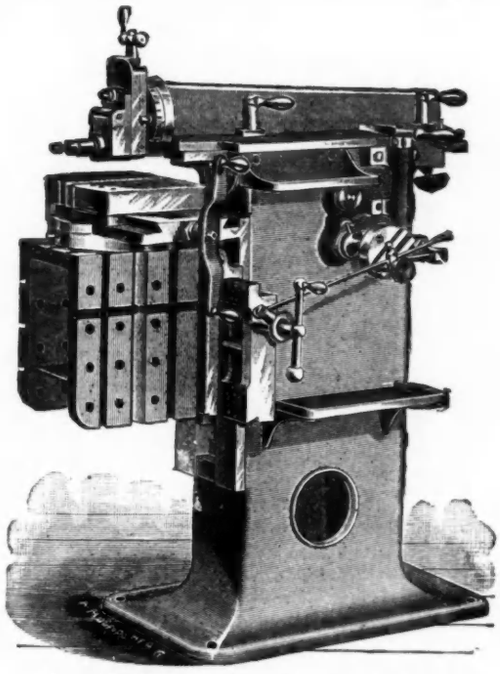
Prentiss Tool and Supply Co.
Machinery & Tools,
115 Liberty Street, New York.
62 & 64 S. Canal St., Chicago, Ill.



..IMPROVED..

15-inch Hendey Shaper.

Latest Improvements.
Useful Attachments.
Strong and Powerful.

...FOR...

Die Work, Tool Room or General Shop Work.

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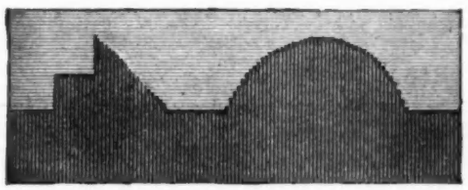
The stroke can be adjusted for curves with machine in motion. The stroke can be adjusted for angles with machine in motion. The stroke can be adjusted for irregular work with machine in motion. It has adjustable table for planing taper work; table can be removed for fastening work to apron. Has a strong graduated swivel vise. Quick work, rapid changes, modern ideas.



This cut shows how stroke can be adjusted with machine in motion by micrometer; adjustment fine and delicate. SEND FOR CIRCULAR.

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THE HENDEY MACHINE CO.

TORRINGTON, CONN.

Agents for the Pacific Coast—PACIFIC TOOL AND SUPPLY COMPANY, San Francisco, Cal.

European Agents, { **CHAS. CHURCHILL & CO., London and Birmingham.**
SCHUCHARDT & SCHÜTTE, Berlin and Vienna.
EUGEN SOLLER, Basel, Switzerland.

(*Continued from page 35.*)

work there is some activity. They are building a mining engine for Mexico and two for the Western States of this country.

A gentleman who represents in this market a prominent company who build a certain line of steam power machinery, has just returned from a tour throughout Europe and speaks thus:

"Not having had opportunities for comparison, I may not be in a position to judge of the present tendencies of American machinery abroad. Certainly the amount of it which has gone to Europe is large, and to me surprising. Of course, machine tools are extensively purchased from this country. In the construction of these we are decidedly the superiors of the European builders. American engines are less in vogue there, for in these a high standard of excellence is attained by them. Neither are American pumps carried from here to the same extent as machine tools. The same remark, I believe, applies to dynamos and motors, although I have not given the matter very close attention. The French and Germans build a high class of electrical machinery. The Central London Underground Railway contract seems to me to have been an exceptional one, and not indicative of general conditions."

We must, however, express our own opinion that in the railway line at least, American electrical machinery is becoming popular in Europe; at least more so than American steam engines.

In this connection is of interest a report which states that the Westinghouse Electric and Manufacturing Company has been awarded by the Metropolitan Electrical Supply Company, of London, a contract for a large electric lighting plant to be installed in that city. The value of the order is said to be between $350,000 and $400,000.

THE PIG IRON MARKET.

is in better shape all along the line. Demand is good and the metal is becoming scarce. Higher prices are the rule. Bar iron, machinery steel, cold rolled steel shafting, etc., are also exhibiting an upward tendency in prices.

Quotations.

NEW YORK, Monday, September 13.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$11 50 @	$12 00
No. 2 foundry, Northern	10 50 @	11 00
No. 2 plain, Northern	10 25 @	10 50
Gray forge, Northern	10 00 @	10 25
No. 1 foundry, Southern	10 75 @	11 00
No. 2 foundry, Southern	10 25 @	10 50
No. 3 foundry, Southern	10 00 @	10 25
No. 1 soft, Southern	10 75 @	11 00
No. 2 soft, Southern	10 75 @	11 00
Foundry forge, or No. 4, South'n	9 75 @	10 00

Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.00 @ 1.05c.; refined, 1.10 @ 1.15c. Store prices: Common, 1.25 @ 1.35c.; refined, 1.30 @ 1.45c.

Tool Steel—Ordinary sizes, standard quality, 6 @ 7c., with some grades perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—Ordinary brands, from store, in small lots, 1.50c.

Cold Rolled Steel Shafting—Base size, from store, in small lots, 1.95 @ 2.00c.

Copper—Carload lots, Lake Superior ingot,

11¼ @ 11⅝c.; electrolytic, 11⅛c.; casting copper, 11c.

Pig Lead—Carload lots, 4.35 @ 4.40c., f. o. b., New York.

Pig Tin—For 5 and 10-ton lots, 13.90 @ 14.00c. probably, but the price is rapidly changing, owing to the silver agitation.

Spelter—Carload lots, New York delivery, 4.30c., f. o. b.

Antimony—The range, according to brand and quantity, is 7¼ @ 8c.

Lard Oil—Prime city, winter make, ordinary quality, in wholesale lots, 41 @ 43c.

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Manufactures.

At St. Louis, Mo., Robinson & Donforth are to erect a factory.

J. C. Daniel, Tarboro, N. C., expects to place ice machinery.

At Lion Hill, Utah, work has commenced on the new Chloride Point mill.

The sawmill of E. Matson & Son, at Marsh Creek, Pa., has been burned.

S. S. Elam, Richmond, Va., expects to install machinery for grinding mica.

At Cordell, Ga., the sawmill belonging to the O'Neals was destroyed by fire.

The Hartford Brewing Company, Hartford, Conn., are to erect a new brewery.

The Walworth Run Iron Foundry, Cleveland, O., was destroyed by fire recently.

At Doylestown, Pa., a grist mill owned by Harry R. Crouthamel was gutted by fire.

The Roberts Machine Company, Collegeville, Pa., will build an addition to its plant.

The machine shops of Torrence & McIntosh, at Monmouth, Ill., have been destroyed by fire.

Daniel Levan & Son, East Lebanon, Pa., are about to install new machinery in their factory.

The Granite City Rolling Mills, near Venice, Ill., it is rumored, will be changed into a steel plant.

The city of St. Louis, Mo., contemplates the erection of an electric traveling crane for engine house.

The Industrial Dyeing & Finishing Works, at Philadelphia, Pa., are intending to erect a new building.

The Crescent Manufacturing Company, Youngstown, O., has been incorporated; capital stock, $10,000.

The American Biscuit & Manufacturing Company, New York City, are intending to erect additions to their plant.

At Jeffersonville, Ky., Dr. Hauss and John Peet are interested in the erection of a cement works at that place.

At Philadelphia, Pa., George Stewart is to build an addition to his factory at Lawrence street and Lehigh avenue.

The machine shop and car house of the Nassau Electric Railroad Company, Brooklyn, N. Y., have been destroyed by fire.

Messrs. F. Rumpf & Son are to erect at Hulmeville, Pa., a woolen mill. The mill, when completed, will employ about 250 hands.

At Denver, Col., the Pueblo Novelty Works & Manufacturing Company has been incorporated by Albert W. Cole and George P. Burris.

It is rumored that Messrs. Reiling, Schoen & David, silk fabric manufacturers of New York City, may remove their plant to Scranton, Pa.

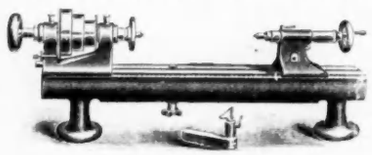
At Troy, N. Y., the paper mill of Messrs. Manning & Paine has been destroyed by a fire, which was caused by the bursting of a dynamo.

The Andrew McLean Company, of Passaic, N. J., recently filed articles of incorporation.

(Continued on page 39.)

No. 3 Bench Lathe, 7 in. Swing, 32 in. Bed,

Is furnished without and with Thread Cutting, Filing and Milling attachments; Back, Jeweling Slide and Drill Rests; Graduating Head or Dividing Engine, Chucks, etc.



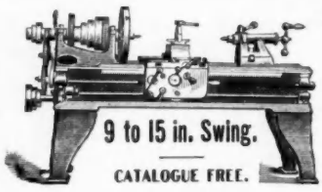
Hand Bench Milling and Profiling Machines; Sub-Press Bases and Stands with Dies.

Special attention given to Manufacturers' Models and Plants for Manufacturing on the Interchangeable System

Ask for the Machinists' Catalogue

The Pratt & Whitney Company,
HARTFORD, CONN., U. S. A.

NEW YORK: 123 Liberty Street. BOSTON: 141 Pearl Street. CHICAGO: 42 South Clinton Street. LONDON, ENGLAND: Buck & Hickman, 280 Whitechapel Road. PARIS, FRANCE: Fenwick Freres & Co., 21 Rue Martel.



CATALOGUE FREE.

SPEAKING OF LATHES! We are building them in various sizes from 9-in. to 15-in. swing, in various lengths, both engine and speed lathes. Our designs are the latest and most approved, while the workmanship, material and finish are of the highest order. Our catalogue will tell you all about them, as well as of our planers, shapers, drills and other tools and supplies.

SEBASTIAN LATHE COMPANY,
117 and 119 CULVERT STREET, CINCINNATI, OHIO.

Slide Valves. A BOOK FOR PRACTICAL MEN on the PRINCIPLES AND METHODS OF DESIGN; with AN EXPLANATION OF THE PRINCIPLES OF SHAFT-GOVERNORS. By C. W. MacCORD, Jr., M.E. 8vo. Cloth. 168 pages and 101 illustrations. $2.00.

JOHN WILEY & SONS, 53 East 10th Street, New York City.

Roughing Reamer.

Finishing Reamer.

FINE REAMERS.
SPIRAL FLUTES.
Also Screw Plates, Taps, Dies and Machinery.
Send for Catalogue.
WILEY & RUSSELL MFG. CO.
Greenfield, Mass., U. S. A.
Agents in London,
SELIG, SONNENTHAL & CO.,
85 Queen Victoria Street.

DYER & DRISCOLL,
PATENT SOLICITORS, 31 NASSAU STREET, N. Y.

have done all my patent soliciting work, both for this and foreign countries, continuously for the past fourteen years.

Thomas A. Edison

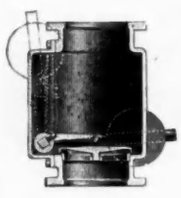
STAR LATHES

★ ★ ★

Foot Power Screw Cutting, Automatic Cross Feed, 9 and 11" Swing.

Send for Catalog B.

Seneca Falls Mfg. Co.
697 Water St., Seneca Falls, N.Y.



Excelsior Straight-Way Back Pressure Valve. This valve has no dash pots, springs, guides or complicated levers to get out of order. It is simple, reliable and well made. Never sticks, and can be relied upon at all times when using exhaust steam for heating; or when used as a relief, or free exhaust on a condensing plant, it has no equal. It is noiseless and free from any complicated attachments

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Die and Tool Steel.

NO BETTER MADE.

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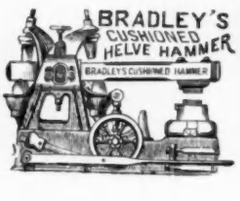

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22 sizes in Helve, Upright and Strap Styles.

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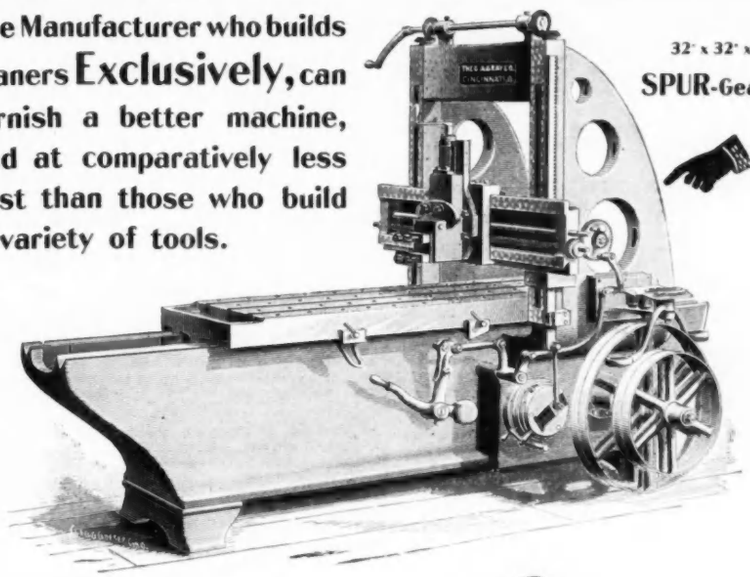
The Manufacturer who builds Planers Exclusively, can furnish a better machine, and at comparatively less cost than those who build a variety of tools.



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The G. A. Gray Co.
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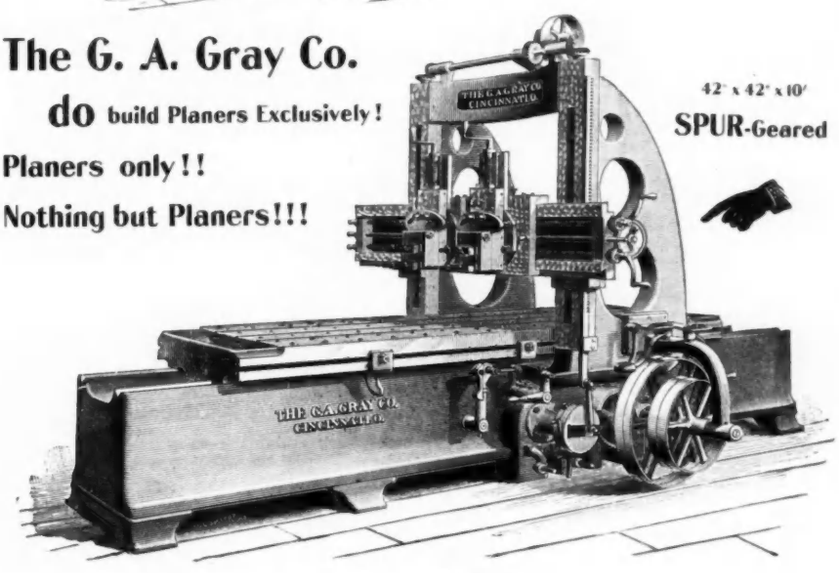
Planers only!!
Nothing but Planers!!!



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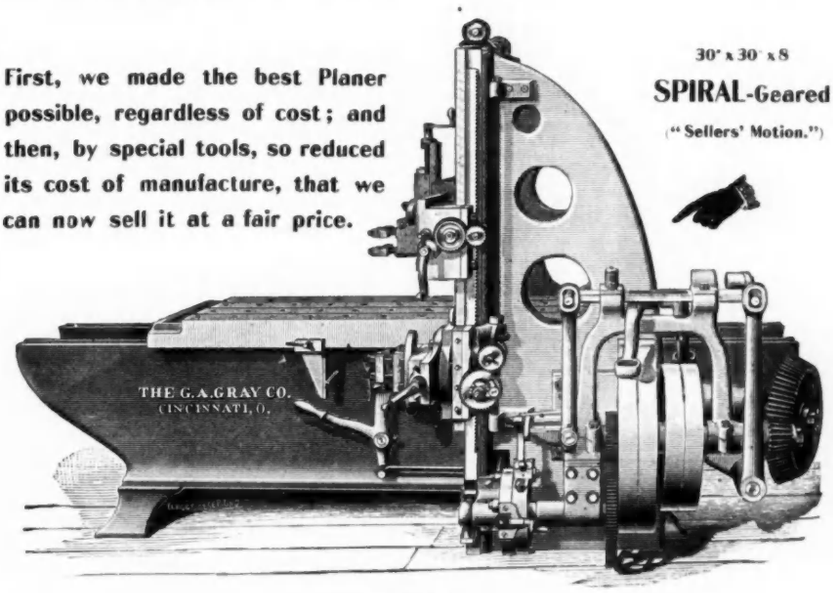

30" x 30" x 8
SPIRAL-Geared
("Sellers' Motion.")

....ADDRESS,....

The G. A. Gray Co., Cincinnati, Ohio.

(Continued from page 38.)

Mr. McLean says that the industry is to be enlarged.

The Duffy Bros., who run a silk mill at Fort Plain, N. Y., have purchased the stone grist mill property in Port Jervis, and will at once remodel it.

The J. C. Spiers Bicycle Manufacturing Company, of Worcester, Mass., are erecting an addition to their plant, 100 x 50 feet and three stories high.

At Buffalo, N. Y., Messrs. Landel & Gimburg will erect a factory, to be used as a forge works, which, when completed, will be used by James Higgins.

The soap works owned and operated by E. C. Andrews, immediately south of the abattoir, in West Indianapolis, Ind., was totally destroyed by fire recently.

The Acme Pipe Clamp Company, East St. Louis, has been incorporated; capital, $50,000. Incorporators: Charles C. Highan, H. A. Wahler and E. L. Adron, Jr.

The New England Pin Company, Winsted, Conn., will soon build a 40 x 100-foot three-story brick addition, to be used by the New England Knitting Company.

At Tallassee, Ala., the Tallassee Falls Manufacturing Company are having built a cotton factory, which will cost, when completed, in the neighborhood of $1,500,000.

Architect Eschweiler is working on plans for a factory building for the John Dahlman estate. The building will be erected on Milwaukee street, Milwaukee, Wis.

The foundry and machine shops of the John Rice & Bro. Company, Stevens Point, Wis., have been destroyed by fire. A large assortment of patterns were also destroyed.

The improvements at the Tidewater Steel Works, Chester, Pa., are going on rapidly, and the plant, which has been idle for some months, will be operated in October next.

The Pennsylvania & New Jersey Brewing Company contemplates the erection of a brewery near Camden, N. J. A. Siegel, Drexel Building, Philadelphia, Pa., is interested.

At Kokomo, Ind., the Concrete Fence Company, in which G. W. Duke, Julius Rosenheimer and others are interested, have leased a building, to be used for manufacturing purposes.

The Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., has bought out the interests of the Gibbs Electric Company, of Milwaukee, Wis. The consideration is said to be $50,000.

Plans have been prepared for a two-story brick factory, 30 x 100 feet, on Mill street, Germantown, Pa., for Taylor Bros. It will be an addition to the firm's plant at Mill and Hancock streets.

At Wilmington, Del., the Kent warehouse has been sold by E. D. R. Sutton to William H. Chamberlain & Co., of Jersey City, N. J., who propose to convert the building into a manufacturing plant.

The Hall Steam Power Company, of 21 Center street, New York City, will erect a factory building at 137-141 Elm street. The building is to be six stories high, about 75 x 125. It will have a complete power plant.

Martinsville, Ind., has secured another industry. J. C. Adams, of Indianapolis, has arranged for starting a brick factory there, with a capacity of 40,000 pressed brick a day to begin with. Jugs and other pottery will be manufactured from the shale later on.

A second addition is to be built to the Palace Silk Mill, at Allentown, Pa., which will be two stories high and 140 x 40 feet in size. When the additions have been completed the capacity of the mill will be almost doubled. A large number of additional hands will be employed.

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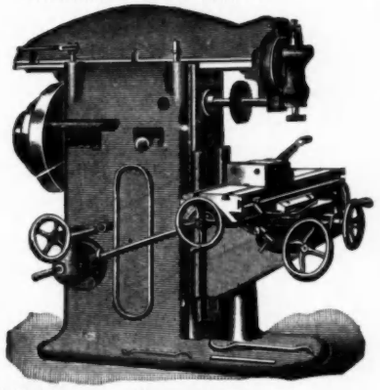

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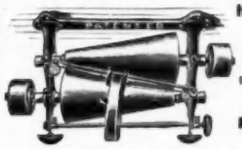

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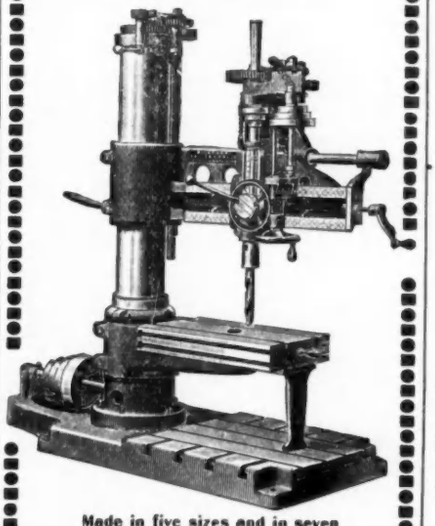

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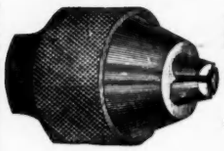

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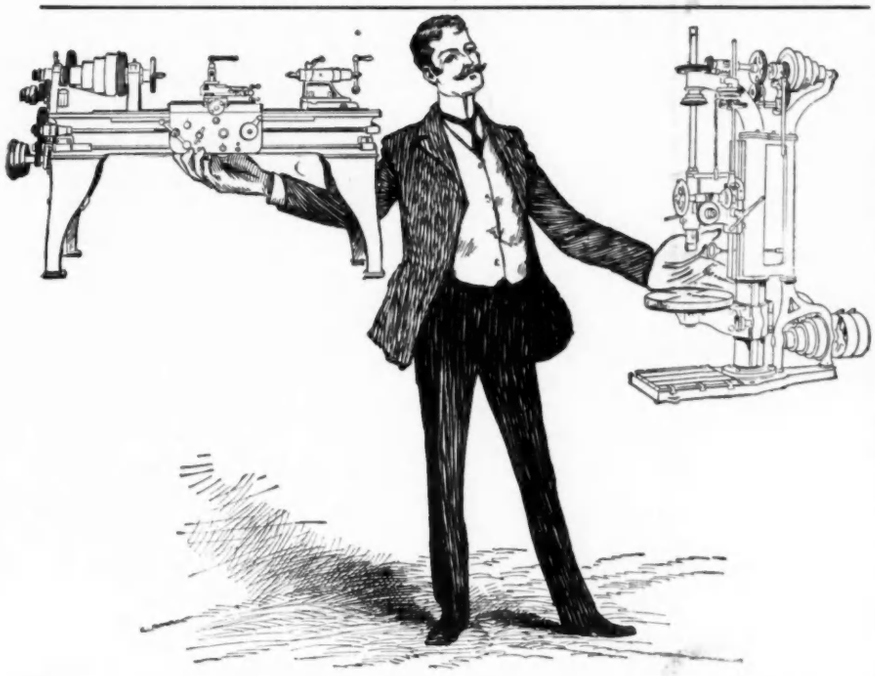

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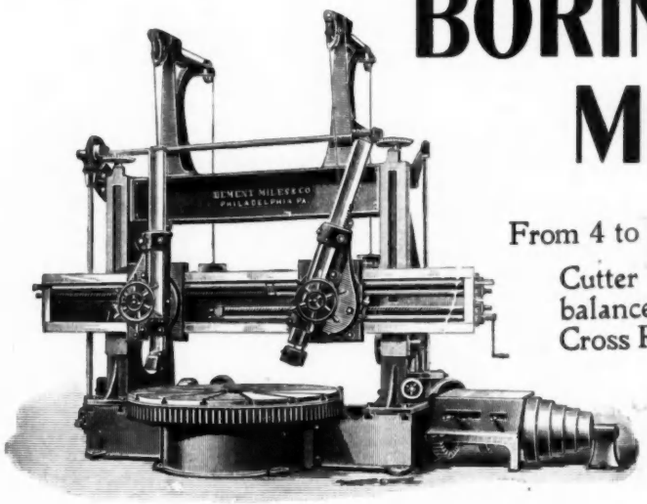

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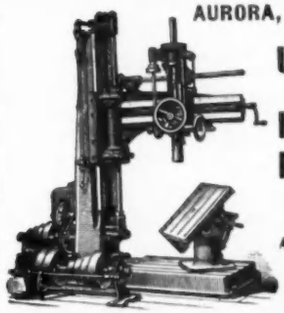

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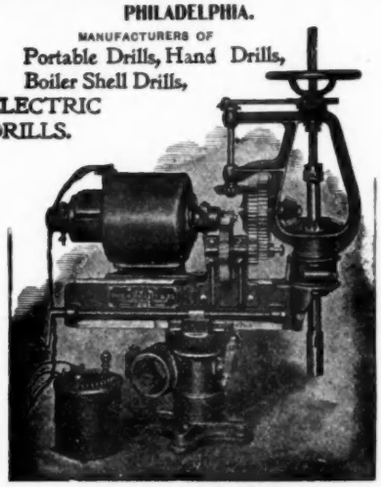

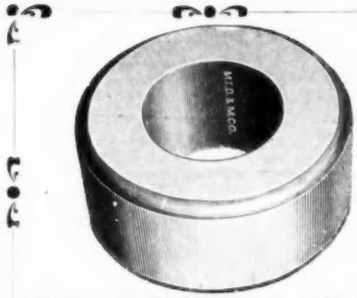

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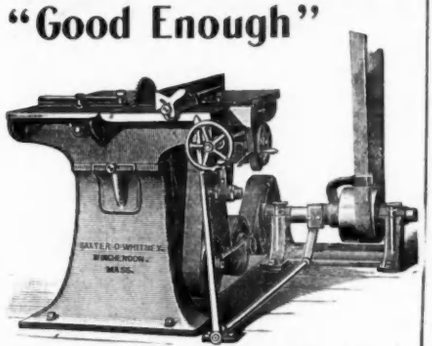

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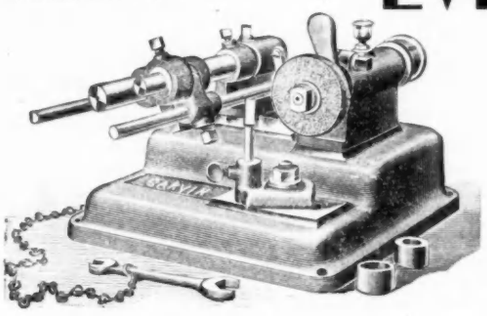

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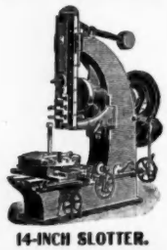

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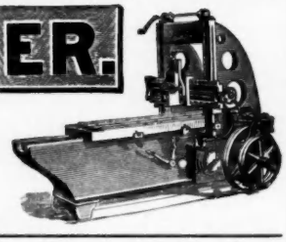

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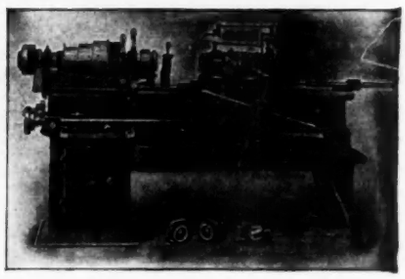

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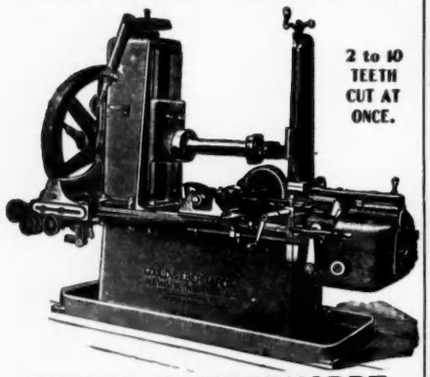

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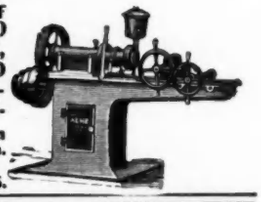

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